

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

Reserve
aTC424
.N3W38
1962
v.9

WATER and RELATED LAND RESOURCES JIMBOLDT RIVER BASIN NEVADA

FOREST SERVICE
RECEIVED

JUN 16 1965

EP&R&S



REPORT NUMBER NINE BATTLE MOUNTAIN SUB-BASIN OCTOBER 1964

Based on a Cooperative Survey

by

THE NEVADA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
and THE UNITED STATES DEPARTMENT OF AGRICULTURE

/

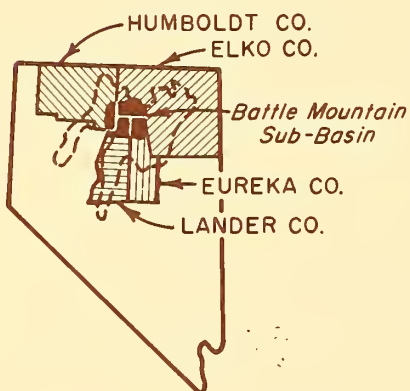
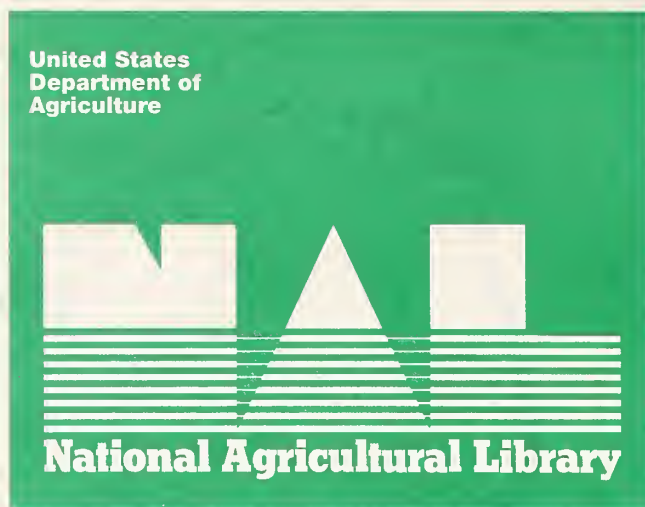
Prepared by

Economic Research Service - Forest Service - Soil Conservation Service

cc: Beattie 6/16/65

L E G E N D

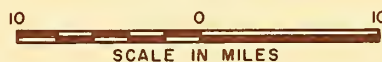
———— Sub-Basin Boundary
 - - - - County Boundary



LOCATION MAP

BATTLE MOUNTAIN SUB-BASIN HUMBOLDT RIVER BASIN ELKO, EUREKA, LANDER & HUMBOLDT COUNTIES, NEVADA

OCTOBER 1964



COVER PHOTOGRAPH

The historic Horseshoe Ranch, Beowawe. The earliest (1872) of the large livestock ranches which grew up along the Humboldt main stem from Beowawe to the Comus narrows after the advent of the Central Pacific Railroad in 1868, it epitomizes the Battle Mountain Sub-Basin's principal industry - livestock raising.

FIELD PARTY PHOTO

REGISTER

REPORT NUMBER NINE
BATTLE MOUNTAIN SUB-BASIN
OCTOBER 1964

Will you please detach and fill out this form; mail it to us,
so that we may send you any additions, changes, or corrections.

Humboldt River Basin Field Party
P. O. Box 982
Elko, Nevada 89801

Name _____

Address _____

U.S. DEPARTMENT OF AGRICULTURE
NATIONAL AGRICULTURAL LIBRARY

DEC 22 1992

CATALOGING PREP.

WATER AND RELATED LAND RESOURCES

REPORT NUMBER NINE

HUMBOLDT RIVER BASIN

NEVADA

BATTLE MOUNTAIN SUB-BASIN

Based on a Cooperative Survey
by

The Nevada Department of Conservation and Natural Resources
and
The United States Department of Agriculture

Forest Service - Soil Conservation Service
Economic Research Service

October 1964

FOREWORD

This is a report for the people of Nevada, and particularly for the people of the Humboldt River Basin, concerning water and related land resources in the Battle Mountain Sub-Basin. It is the ninth of a series of reports resulting from a cooperative survey of the Humboldt River Basin by the Nevada State Department of Conservation and Natural Resources and the U. S. Department of Agriculture. It was prepared by the Soil Conservation Service, Forest Service and the Economic Research Service of the Department of Agriculture.

The State of Nevada seeks constantly to assist local people and their organizations in the conservation, development and management of water resources. It has particular regard for the relationship of water to land and to human resources. This is exemplified by the creation of the Nevada State Department of Conservation and Natural Resources. A primary responsibility of that Department is to cooperate with Federal agencies and local groups and to coordinate State-Federal activities that help solve water and related land problems for the people of Nevada.

The responsibilities of the Nevada State Department of Conservation and Natural Resources, and the cooperative research work already under way along the Humboldt River, set the stage for Federal-State cooperation in developing information on opportunities for improving the use of the land and water resources of the Basin. Accordingly, cooperation was initiated with the U. S. Department of Agriculture under a Plan of Work dated June 3, 1960, with agencies of the Department and of the State of Nevada participating in the survey. It is important here to point out that responsibility for matters concerning State water rights and determination of water supply as it might affect State water rights was assumed by the State of Nevada.

This cooperative survey of the Humboldt River Basin is for the primary purpose of determining where improvements in the use of water and related land resources, some of which have social and economic aspects, might be made with the assistance of projects and programs of the U. S. Department of Agriculture. A major part of the survey is focused on situations where improvement might be brought about by means of Federal-State-local cooperative projects developed under the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress as amended). This survey is in keeping with long-established tradition in the Department of Agriculture of cooperation with States and local entities in the conduct of its work. Further, such cooperation is a most important responsibility of the Nevada State Department of Conservation and Natural Resources.

The U. S. Department of Agriculture-State of Nevada Plan of Work in the Humboldt River Basin offers opportunities for participating in the survey by other Nevada State agencies and Federal agencies. The Bureau of Land Management, as an example, has cooperated with respect to the national land reserve (public domain). Thus, the survey is not limited, but is, rather, as broad in scope and agency participation as is required to meet the agreed-upon objectives.

The entire Humboldt River Basin is being studied by segments identified as sub-basins.

This report contains much information for study and use in understanding and solving some of the existing water and land resource problems in the Battle Mountain Sub-Basin. The report reveals that there are no opportunities for Federal-State-local project-type developments under the present interpretations of the Watershed Protection and Flood Prevention Act. Opportunities for development and adjustment do exist, however, through other Federal and State programs.

I wish to recognize the excellent work of the U. S. Department of Agriculture and the State Department of Conservation and Natural Resources in this cooperative effort. I consider that this report will serve the best interest of the people in the Humboldt River Basin and the State of Nevada.

A handwritten signature in dark ink, reading "Grant Sawyer". The signature is written in a cursive style with a large, looping initial "G".

Governor of Nevada

HUMBOLDT RIVER BASIN SURVEY

BATTLE MOUNTAIN SUB-BASIN REPORT

CONTENTS

	<u>Page</u>
Foreword, Governor of Nevada	i
Summary -----	1
Authority and Organization -----	1
Historical Information -----	1
Settlement -----	1
Floods -----	8
Fires -----	8
Previous Studies -----	8
General Sub-Basin Characteristics -----	9
Geology -----	9
Ground Water -----	12
Soils -----	12
Precipitation -----	13
Growing Season -----	13
General Cover Types -----	14
Water Yield -----	20
Land and Water Use -----	25
Land Status -----	25
Land Use -----	25
Water Rights -----	26
Water Use -----	27
Irrigation Methods -----	28
The Agricultural Industry -----	28
Ranch Characteristics -----	29
Crop Production -----	29
Livestock Production -----	31
Livestock Marketing -----	32
Transportation -----	33
Water-Related Problems in the Sub-Basin -----	34
Agricultural Water Management -----	34
Seasonal Distribution of Water -----	34
Soils -----	34
Seepage Loss -----	35
Drainage -----	35
Irrigation Efficiency -----	35
Control of Water -----	36
Flood Damage -----	36
Wet-Mantle Floods -----	36
Dry-Mantle Floods -----	39

	<u>Page</u>
Vegetal Conditions-----	40
Range and Watershed -----	40
Phreatophytes-----	48
Timber Management -----	50
Fire Protection -----	51
Recreation and Wildlife -----	51
Recreation Developments-----	51
National Land Reserve (Public Domain)-----	53
Wildlife -----	53
Deer and Other Big Game Hunting-----	53
Fisheries-----	55
Small Game -----	56
Programs Other Than Project-Type Developments Available for the	
Improvement of Water and Related Land Resources -----	56
Technical Assistance and Cost-Sharing Under Public Law 46-----	56
Agricultural Water Management -----	57
Vegetal Improvement -----	60
Watershed Protection and Erosion Control -----	61
Possibilities for Water Salvage -----	61
Bureau of Land Management Programs -----	61
National Land Reserve (Public Domain)-----	61
Fire Protection -----	62
Watersheds with Opportunities for Project-Type Development -----	63
References-----	65
Appendix I -----	72
Appendix II (Table of Contents only) -----	95
Maps	
Land Status	
Soils, Range Sites, and Forage Production	
Land Use and Phreatophytes	

TABLES

<u>Number</u>	<u>Page</u>
1. Acreage of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Battle Mountain Sub-Basin -----	41
2. Phreatophyte acreage and annual ground water use, Battle Mountain Sub-Basin-----	49
3. Potential developments, recreation inventory report, 1961 and subsequent supplements, national land reserve, Battle Mountain Sub-Basin-----	54
4. Soil characteristics, Battle Mountain Sub-Basin -----	77
5. Interpreted soil characteristics, Battle Mountain Sub-Basin-----	82

<u>Number</u>	<u>Page</u>
6. Summary of Water Balance Studies by elevation zones for watersheds in the Battle Mountain Sub-Basin for an 80% frequency (chance)-----	92

FIGURES

<u>Number</u>	<u>Page</u>
1. Annual streamflow distribution, Rock Creek gage near Battle Mountain-----	21
2. Flow diagram of gross water yields, depletions, inflow, and outflow in acre-feet for watersheds in the Battle Mountain Sub-Basin for an 80% frequency (chance) -----	23
3. Watersheds delineated for water balance studies, Battle Mountain Sub-Basin-----	91

PHOTOGRAPHS

<u>Number</u>	<u>Page</u>
The historic Horseshoe Ranch, Beowawe. The earliest (1872) of the large livestock ranches which grew up along the Humboldt main stem from Beowawe to the Comus narrows after the advent of the Central Pacific Railroad in 1868, it epitomizes the Battle Mountain Sub-Basin's principal industry - livestock raising. (Field Party Photo)	Cover
1. Ruts of the California Emigrant Trail, west of Emigrant Pass. Looking southward toward the Humboldt River at the Gravelly Ford crossing of the emigrant trail. The Shoshone Mountains west of Crescent Valley are visible in the right background. -----	2
2. The old and the new. On the left the Southern Pacific's Daily Mail hustles over the modern heavily ballasted, high-speed rails of the Southern Pacific transcontinental main line at Dunphy, and in vivid contrast immediately to the right is the meandering, abruptly curved grade of the Central Pacific Railroad, built through this portion of the Humboldt Valley in November 1868 and abandoned in the line-straightening changes made by the Southern Pacific from 1901 - 1903. Looking southeasterly up the Humboldt Valley, toward the Tuscarora Range. -----	3
3. Midas, the once booming gold camp tucked under the slopes and escarpments of the Snowstorm Mountains on the north side of Squaw Valley, as it appears today.-----	5
4. Getchell mining operations, Osgood Mountains, 1964 looking east across Kelly Creek toward the Snowstorm Mountains (left background).-----	6

5. U.S. Highway 40 in the Twin Summit area, looking east toward the crest of Emigrant Pass. On the left may be seen a remnant of the old Victory Highway, first located across this pass in the early 1920's. The California Emigrant Trail traversed down Emigrant Canyon to the right, passing by the Upper and Lower Emigrant Springs, marked by the two clumps of trees in the distance. The lower springs became the site of Primeaux Station after the construction of the first auto highway in 1920 and shortly thereafter. The disastrous dry-mantle flood of August 12, 1941, swept down the draw in the left middle distance and across the highway, trapping two automobiles and carrying them down Emigrant Canyon. One man was drowned. ----- 7
6. Removal of sagebrush-perennial grass cover by the 800-acre Upper Clover Valley Fire of October 1955, as seen in 1964. Although this fire occurred almost 10 years ago, it has placed a scar on the Evans Creek Watershed which will not soon be healed or erased. ----- 9
7. Massive rhyolitic lava flows form prominent rimrock along the Snowstorm Mountains, northwest side of Clover Valley. ----- 10
8. Big sagebrush-grass type, upland bench and terrace site, Boulder Flat, looking westerly down the Humboldt Valley toward Argenta Rim on the left and Stony Point on the right. The grass understory here is primarily cheat. ----- 14
9. Black greasewood type, saline bottomland site, Boulder Flat at the T S Ranch, looking south toward the Argenta Rim at Dunphy. ----- 15
10. Quaking aspen at the drainage heads, Snowstorm Mountains, northwest of Midas. ----- 15
11. Low sage (*Artemisia arbuscula*) type, claypan bench site, head of Rodeo Creek, Boulder Flat. ----- 16
12. Crested wheatgrass seeding, north of Antelope Creek. It is estimated that 400,000 acres of rangeland in this sub-basin can be seeded to improved grass species. ----- 17
13. Shadscale-bud sagebrush type, dry desert uplands site, looking north toward lower Clover Valley. There is little grass or forb understory present. ----- 18
14. Grassland type primarily used for pasture, Humboldt River bottomland at the T S Ranch, looking south toward the Argenta Rim. Principal grass species present are Great Basin wildrye, alkali sacaton, creeping wildrye, and saltgrass. ----- 19
15. Black greasewood type, semi-playa site, northwest of Battle Mountain. Very little if any vegetation appears as understory to the greasewood in this site. ----- 19
16. One of the several large irrigation wells present in this sub-basin. T S Ranch, five miles west of Dunphy. The well is used to irrigate alfalfa fields when irrigation water from the Humboldt River is inadequate because of low flow. ----- 27

17. Nomad alfalfa, Horseshoe Ranch, near Beowawe, Nevada, showing border irrigation. Water table fluctuates from three to 10 feet. Stand is approximately six years old and is producing from four to five tons per acre. Stand appears to be thickening. ----- 28
18. Hay fields, T S Ranch, Boulder Flat, 10 miles north of Dunphy Ranch, looking south. This field is border-irrigated from two irrigation wells, and has produced from 5.5 to 6.5 tons per acre from three to four cuttings. ----- 30
19. Creeping wildrye meadow hayland, near Beowawe, Nevada, which produces approximately two tons per acre. ----- 31
20. Hereford cattle at a saltground, Snowstorm Mountains, northwest of Midas. ----- 32
21. Two interstate railroads, Southern Pacific and Western Pacific, serve the sub-basin area. Shown here is the Western Pacific main line at Dunphy, looking southeast toward Beowawe. (Between Wells (Alazon) and Winnemucca (Weso), under a joint track agreement between the two railroads, the Western Pacific track is used by eastbound traffic, the Southern Pacific by traffic westbound.) ----- 33
22. Semi-controlled wild flooding, meadow haylands, T S Ranch, near main ranch headquarters, looking west. ----- 34
23. High saline-alkali soils, along Highway 40, Dunphy Ranch. Shows an attempt to reclaim these lands by deep furrow planting, on level land, and irrigating down the furrows. Species planted were tall wheatgrass (*Agropyron elongatum*), and yellow sweetclover (*Melilotus officinalis*). Prior to planting, 3.5 tons of gypsum were applied per acre. -----
24. Flooding of Humboldt meadowlands, Horseshoe Ranch, Beowawe, February 12, 1962. ----- 39
25. Big sagebrush-grass range in low forage production class, upland bench and terrace site north of Gravelly Ford on the Humboldt, looking south toward Crescent Valley and the Shoshone Range. The former perennial grass understory to the big sagebrush has here been replaced by fanweed (*Lepidium perfoliatum*) and cheatgrass. ----- 40
26. Semi-playa range site in low forage production class, lower Pumpernickel Valley. This site, wherever found, has no improvement potential beyond the low forage production class. ----- 40
27. Big sagebrush-grass range in fairly high forage production class, steep mountain slopes and basins site. St. John Fields, Jenkins 25 Ranch, Tuscarora Range. The principal perennial grasses present are Nevada bluegrass, Idaho fescue, *Hesperochloa* (*Hesperochloa kingii*), and bluebunch wheatgrass. Stocking rates for cattle here have been estimated to range from three and one-half to six and one-half acres per A.U.M. Looking northwest toward the Willow Creek Reservoir. ----- 46
28. Eroded and silted stream channel, lower Rock Creek, two miles north of the Antelope Creek Road. ----- 47

29. One of the many fine aspen stands in the canyons and basins at the head of Rock Creek. Stands such as this are most valuable as watershed protection types, or for their aesthetic value and shade. If properly developed, so as to avoid too great human congestion and trampling, these extensive aspen groves offer many excellent opportunities for campground and recreation area development.----- 50
30. Pioneer graves at historic Gravelly Ford, where the California Emigrant Trail forded the Humboldt River, about five miles east of Beowawe, looking southwest toward the Shoshone Mountains. The small cross marks what was long mistakenly presumed to be the 1846 grave of John Snyder, murdered by James Reed, both of the ill-fated Reed-Donner Party. Once, a well-kept picket fence surrounded the approximately 30 graves of pioneers who died at this grim crossing. Now, the site has been abandoned to the ravages of weather and livestock trampling. Its premier position in the annals of western history, and its present dilapidated condition, make its immediate repair and permanent upkeep a matter of State and national concern.----- 52
31. The grave of Lucinda Duncan, member of an emigrant party of the early 1860's who died and was buried at the old emigrant camp site along the Humboldt near the railroad tracks at the right side of the photograph. With the advent of the Central Pacific Railroad late in 1868, her remains were moved to their present resting place. In refreshing contrast to the graves at Gravelly Ford, this site, commonly known as the Maiden's Grave, has been carefully kept up through the years by the Southern Pacific Railroad. (Looking northwest down the Humboldt Valley; the hamlet of Beowawe is in the left background.)----- 52
32. Willow Creek Reservoir, eight miles above Squaw Valley Ranch, looking west. First constructed in 1884 by the English-owned Nevada Land and Cattle Company, Ltd., for irrigation on its Squaw Valley Ranch, it was for many years a prime trout fishery. However, repeated depletions of the reservoir water in the 1950's, coupled with the roily waters resulting from wave action on the mud of its silty bottom, have greatly reduced its present value for fishing. ----- 55
33. Constructing a concrete ditch, Dunphy Ranch. Ditches carry the water from one well and a sump to the alfalfa fields. ----- 58
34. Typical rock and brush dam, Humboldt River, on W. E. Licking Ranch, near Battle Mountain, Nevada. This type of diversion makes control of water difficult.----- 59
35. Two-way irrigation structure, main T S Ranch, Humboldt River bottomlands. Irrigation water from either the wells or the river flows through this irrigation system to irrigate the alfalfa fields. ----- 59
36. Site of proposed dam for reservoir on lower Rock Creek, three miles above canyon mouth where Rock Creek discharges on Boulder Flat.----- 64

ORGANIZATION OF REPORT

The report on the Battle Mountain Sub-Basin is divided into three main sections. The first section is an overall report on the sub-basin; the remaining two sections consist of Appendix I and Appendix II, respectively.

Appendix I is attached to all the report copies, and contains pertinent textual matter concerning the sub-basin which is of value to the general reader.

Appendix II is produced in a relatively limited number of copies. Its small appeal to the general reader renders it unsuitable for inclusion with the report copies for general distribution. However, this type of material does have potential value as an information reservoir for technicians, administrators, and resource managers concerned with the Battle Mountain Sub-Basin. Copies of this appendix are available upon request.

SUMMARY

The white man's use and development of water, cropland, range, mineral, and other resources in the Battle Mountain Sub-Basin can be roughly divided into three periods. The first period, 1828-1841, was the era of the fur-trapper and mountain man. The second period, 1841-1869, marked the period of westward wagon-train emigration to California. To all intents and purposes, this period terminated with the joining of the Central Pacific-Union Pacific rails at Promontory, Utah on May 10, 1869. The third period, from 1869 to the present, marked the development of the sub-basin's livestock and mining industries, and the first large-scale use and exploitation of its resources.

The sub-basin is located in the north central part of the Humboldt Basin. It lies in portions of four counties; Elko, Eureka, Lander and Humboldt. The area contains about 1,753,000 acres, and includes the Humboldt bottomland between Palisade and Comus, and the drainages north of the river from the Osgood Mountains to the Tuscarora Mountains. Whirlwind Valley and other short drainages south of the river are also included.

Of the 1,753,000 acres in the sub-basin 51 percent is national land reserve (public domain), 3.3 percent is Bureau of Reclamation lands (Rye Patch Project), 0.1 percent is State or county-owned, 45 percent is private land, and a small acreage is held in trust by the Bureau of Indian Affairs for the Battle Mountain Indian Colony.

Livestock production continues to be the dominant agricultural activity. Ranch numbers have been decreasing in past years, while ranch size has increased. At present, there are 18 livestock ranch operations in the sub-basin, which vary in size from about 500 to 200,000 acres of private land, plus licensed grazing on public lands. Fifteen ranches are cattle operations, and three run both cattle and sheep; 13 of the 18 are headquartered in the sub-basin. The total number of livestock on ranches in the sub-basin is about equally divided between sheep and cattle, and is estimated to be 17,000 head of each. The privately owned lands are used for the production of irrigated forage crops and range forage. The national land reserve (public domain) is used primarily for spring-fall and summer range for livestock, as summer and winter range for big game, and as a year-long habitat for other wildlife. The higher mountainous portions of both the private and public lands comprise the principal water-yielding areas.

Cover types are perhaps as varied as any in the Humboldt Basin. They range from dense nearly pure to admixture stands of trees, shrubs, grasses, or forbs in the higher elevations to practically nothing in the low semi-playa bottomlands. Generally, however, either the big sagebrush-grass or black greasewood vegetal sites predominate, with approximately 55 and 14 percent, respectively, of the total area being occupied by these two types. Other range vegetal sites found are shadscale-budsage, Utah juniper, and browse-aspen-grass. Phreatophytic plants of low economic value consist mainly of greasewood, rabbitbrush, alkali seepweed, rose, willow, and saltgrass. Except for willow, they occur as relatively pure stands of each species, or as admixtures of several. About 75 percent of the 1,722,400 acres of usable range land is currently in the low forage production class, and less than 11 percent is in the fairly high forage production class. It is estimated that there may be as much as 400,000 acres of rangeland that can be seeded to improved grass

species.

Climate in the sub-basin is arid, with only a slight variance in average annual temperatures along the Humboldt bottomland between Comus and Beowawe (48 to 49 degrees F). The length of growing season (28 degrees F) in this area is estimated to average 125 days. On Rock Creek, in the Squaw Valley Ranch area, the growing season is thought to be in the range of 90 to 100 days. Average annual precipitation on the irrigated land is estimated to vary from six to seven inches along the Humboldt River between Comus and Beowawe, and is approximately nine inches in Squaw Valley. In the higher elevations, the precipitation is estimated to be 25 inches in the Tuscarora Mountains (over 8,000 feet), and 20 inches in the Snowstorm and Osgood Mountains (over 8,000 feet).

The annual water balance studies made by the Field Party indicate that during an 80 percent frequency flow year (80 percent chance, expected to be equaled or exceeded eight out of 10 years) the approximate gross water yield from the sub-basin is 21,500 acre-feet. Of this total, 3,700 acre-feet drain into the Humboldt River (surface and subsurface). Most of this water is from Rock Creek and its tributary drainages. The gross water yield plus inflow from the Humboldt River at Palisade and Pine Creek is estimated to total about 142,500 acre-feet annually for an 80 percent year, and the water uses and losses are calculated to be 124,000 acre-feet. The discharge at the Comus gage for this same frequency year is about 74,500 acre-feet. To satisfy present plant water needs and irrigation use throughout the growing season, 56,000 acre-feet of water come from ground water storage. To offset this depletion, the ground water is recharged during higher-yielding years.

The principal water use is by 213,000 acres of phreatophytes (91,000 acre-feet, of which 52,600 are used by phreatophytes of low economic value), and by 28,000 acres of irrigated crops (29,000 acre-feet). The hay and phreatophyte areas are located principally in the bottom lands. Most of the native hay and pasture land is irrigated continuously during the period of high seasonal stream flow. Approximately 3,300 acres are planted to alfalfa or alfalfa-grass. Most of the alfalfa, and a small acreage of meadow hay, receive supplementary irrigation throughout the growing season, with water from reservoirs, wells, and springs.

There is a limited number of improved irrigation developments in the sub-basin. These consist of land leveling, land smoothing, drainage, diversion structures, spreader ditches, irrigation wells, and storage reservoirs. The bulk of the irrigation is done by a semi-controlled type of wild flooding; however, border irrigation is used on cropland which has been leveled or smoothed.

The principal problems affecting agricultural water management are: Poor seasonal distribution of water; saline-alkali soils; excessive seepage loss from stream channels and ditches; low on-the-farm irrigation efficiency; inadequate control of irrigation water; and flooding.

The Battle Mountain Sub-Basin has been subjected to many periods of flooding or high water. From 1881 to the present time there have been nine wet-mantle floods and

one dry-mantle flood which have caused major damages. These have been in the form of watershed erosion, stream and gully erosion, cropland inundation and sedimentation, damage to irrigation structures, and livestock losses. In addition, damages have been inflicted on roads, bridges, buildings, and railroad facilities.

As the population increases, and with improved roads and trails, the sub-basin's recreation potential will become better known and developed. The Tuscarora Mountains are presently one of the principal deer-harvest regions in northeastern Nevada. With fuller recognition and development of the largely untapped potentials for camping, picnicking, back-country travel, hunting Indian artifacts, and delving into Nevada's exciting past by visiting the many historic sites located here, recreation use should become one of the sub-basin's outstanding features.

The principal fishing streams include upper Rock, Toe Jam, Nelson, and Lewis Creeks in the Tuscaroras, Frazier Creek in the Snowstorms, and lower Rock Creek above the confluence with Humboldt River. The higher elevation streams are fished very lightly; they are populated with native cutthroat trout. Lower Rock Creek contains largemouth bass, white crappie and sunfish, as well as an abundant supply of giant bullfrogs. Prior to 1954 Willow Creek reservoir provided good fishing as the cutthroat trout (15 to 20 inches long) ran upstream in the spring of the year. The reservoir was completely drained in 1954, 1959, and 1960. These depletions, plus the harmful effects of heavy siltation in the reservoir bottom, have decreased the value of this body of water as a good fishery.

Chukar partridge are abundant throughout the sub-basin. Other small game present in lesser quantities include valley quail, mountain quail, sage grouse, water fowl, and cottontails.

Regular Department of Agriculture and other Federal and State programs can provide assistance in accomplishing many needed improvements in the sub-basin. The programs of the Bureau of Land Management, including fire protection, provide for the protection and improvement of the Federal lands that agency administers, within the scope of currently available funds.

A review of the sub-basin did not reveal any project-type developments which might be solved under the present interpretations of the Watershed Protection and Flood Prevention Act.

HUMBOLDT RIVER BASIN SURVEY

BATTLE MOUNTAIN SUB-BASIN REPORT

AUTHORITY AND ORGANIZATION

The need for continually improving the conservation and use of water and related land resources has long been recognized by Federal, State, and local agencies. A pertinent development of this continuing interest is River Basin studies under Section 6 of Public Law 566, as amended and supplemented. In Nevada such a survey is underway by the U. S. Department of Agriculture and the Nevada State Department of Conservation and Natural Resources.

The Secretary of Agriculture is authorized under the provisions of Section 6 of the Watershed Protection and Flood Prevention Act to cooperate with other Federal and with State and local agencies in making investigations and surveys of the watersheds of rivers and other waterways as a basis for the development of coordinated programs.

General direction for the U. S. Department of Agriculture in the conduct of the studies and preparation of the report was provided by a USDA Field Advisory Committee composed of representatives of the Soil Conservation Service, Forest Service, and Economic Research Service. The USDA River Basin Representative served as advisor and consultant to the committee.

General direction for the State of Nevada was provided by the Director of the State Department of Conservation and Natural Resources.

A Field Party, composed of representatives of the Soil Conservation Service, Forest Service, and Economic Research Service completed the field work and prepared this report.

Grateful acknowledgement is made to all individuals and to the personnel of other State and Federal agencies who gave their counsel and technical assistance in the preparation of the report.

HISTORICAL INFORMATION

Settlement

The white man's use of the Battle Mountain Sub-Basin - including the Humboldt River main stem from Palisade to Iron Point - and the development, use, and exploitation of its water, cropland, range, mineral, and other resources can be roughly divided into three periods. The first period, 1828-1841, was the era of the fur-trapper and mountain man. The second period, 1841-1869, marked the period of westward wagon-train emigration to California. To all intents and purposes, this period terminated with the joining of the Central Pacific-Union Pacific rails at Promontory, Utah on May 10, 1869. The third period, from 1869 to the present, marked the development of the sub-basin's livestock and

mining industries.

Most of the Battle Mountain Sub-Basin use during the first two periods, 1828-1869, was confined to that portion on or adjacent to the Humboldt bottomlands. On November 16, 1828 Peter Skene Ogden, the first white man to enter the Humboldt Basin, on the fifth of his Snake Country Expeditions for the Hudson's Bay Fur Company, passed Iron Point on his way upstream along the Humboldt, trapping beaver and other fur-bearers as he went.

The last of the British fur brigades trapped the sub-basin in June 1831, when John Work, Ogden's successor, traversed the main Humboldt reach from present Dunphy westward as far as Winnemucca. The final significant incursion into the Humboldt's by then scanty fur resources occurred in 1833-1834, by a sub-group of Captain Benjamin Bonneville's party of American fur trappers.

The period of the American hegira along the Humboldt to California, the promised land, has been documented in the reports covering the Elko Reach and the sub-basins above Palisade. Many of the most historically significant points on the emigrant trail are located within this sub-basin (see Recreation Developments, also see photograph 1).

The advent of the Central Pacific rails up the Humboldt Valley in 1868-1869 set the stage for the third and last phase of the development and exploitation of the sub-basin's resources (see photograph 2). In November 1868 Argenta Station was set up as a terminus for the freight and stage roads serving the bustling mining camps in lower and upper Reese River Valley. Early in 1870 the station and town were moved five miles west to the junction of Reese River and the Humboldt, and a new town, named Battle Mountain after the nearby mining district, was established there to service the Reese River mines.

Photograph 1. - Ruts of the California Emigrant Trail, west of Emigrant Pass. Looking southward toward the Humboldt River at the Gravelly Ford crossing of the emigrant trail. The Shoshone Mountains west of Crescent Valley are visible in the right background.

FIELD PARTY PHOTO 6-778-8





Photograph 2. - The old and the new. On the left the Southern Pacific's Daily Mail hustles over the modern heavily ballasted, high-speed rails of the Southern Pacific transcontinental main line at Dunphy, and in vivid contrast immediately to the right is the meandering, abruptly curved grade of the Central Pacific Railroad, built through this portion of the Humboldt Valley in November 1868 and abandoned in the line-straightened changes made by the Southern Pacific from 1901-1903. Looking southeasterly up the Humboldt Valley, toward the Tuscarora Range.

FIELD PARTY PHOTO

After the construction of the railroad, which opened this portion of Nevada to eastern and western markets, the white man's use of the sub-basin began in earnest. In the Humboldt meadows from Beowawe to Iron Point, where the covered wagons had recently plodded their way westward, some of Nevada's largest and best-known range livestock operations sprang up.

The first of these was the Horseshoe Ranch at Beowawe, established in 1872 by Dr. George W. Grayson of San Francisco and Aaron Benson of Beowawe under the famous Horseshoe iron, the first brand to be registered in Lander County. Dr. Grayson and his various partners owned or controlled over 200,000 acres in Elko, Eureka, and Lander Counties. In addition to the Horseshoe brand, they operated under 26 other irons.

After passing through many different ownerships, in 1936 the ranch was acquired by Dean Witter, San Francisco financier. At this time Witter also acquired much of the T S range on Maggie Creek below the Jenkins Stampede Ranch. Sometime after 1950 Mr. Witter sold to Baldwin M. Baldwin, who in 1956 sold to R. H. Hadley. In 1958 Hadley and his son R. H. Hadley, Jr. sold the home ranch at Beowawe to Gordon Macmillan, the present owner, keeping for themselves the Carlin and Simon Fields and the Upper Horseshoe (Red House) Ranch, all on Maggie Creek. The Hadleys retained the old Horseshoe brand, altered in 1933 to the Horseshoe-Bar.

Another and one of the greatest cattle operations in central and eastern Nevada, the T S Ranch, was developed at Dunphy, a few miles farther down the Humboldt from the Horseshoe. William Dunphy, pioneer eastern Nevada cattleman, began putting his T S

empire together in 1877, when he initiated operations at Dunphy under the T S iron. By 1884, at which time he operated under 24 registered brands in addition to the T S, he was described in a Winnemucca newspaper as "the millionaire cattle king, whose friends are booming him for the U. S. Senate".

From 1885 to 1931 the T S holdings were a part of the Dunphy Estate; from 1931 until 1961 they were owned by several individuals and corporations. In the latter year, they were purchased by Thornton and Ash, of Arizona and California, the present owners. The T S is now almost completely fenced, including the Federal range, and comprises a greater percentage of deeded lands within its boundaries than any other ranch in the sub-basin.

The Jenkins Company, another old name in Nevada livestock raising (1877), had originally been a sheep outfit operating out of Battle Mountain. By 1891 W. T. Jenkins was known as one of the largest sheep and wool growers in Nevada, with flocks numbering some 25,000 head. His ranges extended over Humboldt, Lander, and Elko Counties. Around 1916 the company began branching out into the cattle business. By 1949, when the company took over the 25 Ranch and started operating under the J H L, the 25, and at least seven other irons it owned or controlled over 280,000 acres in the aforementioned counties. Included in this acreage were the former T S Stampede Ranch on upper Maggie Creek and the L. H. St. John Ranch on upper Willow Creek, with its great acreage of some of the finest perennial grass-sagebrush range yet remaining in Nevada. Today, under a corporation guided by the decedents of the founder, the company is still one of Nevada's foremost cattle and sheep operations. Its headquarters are still at Battle Mountain.

Among other large livestock operations in the sub-basin was the Nevada Land and Cattle Company, Ltd., in Squaw Valley (upper Rock Creek), Willow Creek, and Kelly Creek. This company, formed in England, started extensive alfalfa irrigation operations on Kelly Creek in January 1881. It also purchased the old Owyhee Land Association holdings (Graves and Parkinson) on upper Rock Creek in 1883. By November 1884 the company had completed the original Willow Creek dam and reservoir. The dam was 25 feet high, 175 feet long, and was faced on the reservoir side with three-inch planks. It formed a reservoir one-half mile wide and two miles long, to irrigate 2,000 acres on the company's Squaw Valley Ranch. To facilitate irrigation operations, a 10-mile telegraph line was constructed, linking the dam site with the ranch.

The disastrous winter of 1889-1890 broke the English company; it suffered livestock losses estimated at 98 percent. Its holdings were sold in 1895 to Herbert Guernsey of Elko, and since that time the original holdings have been split and have passed through several ownerships, including Pedro Altube's historic Spanish Ranch at Tuscarora, and the Henry Moffat Company of San Francisco. At present Ellison and Allied Ranching Companies own or control these lands.

Mining activity in the sub-basin has not been too extensive, except for the Midas District and the tungsten-gold mines in the Osgood Mountains. The West iron deposits in Safford Canyon, tributary to the Humboldt in Palisade Canyon at Barth, were originally

discovered and described by geologists of the Fortieth Parallel Survey. Near the same location in 1881 James Safford discovered the Onandaga Silver Mine. Up to 1910 total silver production there was valued at approximately \$200,000. About 1907 the American Smelting and Refining Company leased the old West Iron Mine from the Central Pacific, and worked it a number of years to obtain iron flux for the company's Salt Lake smelters. The lease was relinquished by 1923, and for almost 40 years the mine was abandoned and flooded. Starting in 1962, however, the old Barth pit was reactivated, and at the present writing an extensive open-pit iron ore operation is being carried on by Nevada Barth, headquartered at Winnemucca.

Gold was discovered in the Midas (Gold Circle) District in 1907, during the general upsurge in prospecting all over Nevada following the fabulous gold strikes at Tonopah and Goldfield. A rush ensued, and a townsite - called Gold Circle at first, but later changed to Midas - was laid out. The peak of the boom period lasted from 1916 to 1921; during this period, the town's population reached 2,000 (see photograph 3). The principal operation was the Elko Prince Mine and Mill. The district had produced almost \$2,500,000 in gold, silver, and copper by the end of its peak production in 1921.

The Elko Prince Mill burned in 1922, and ore production gradually dwindled until 1942, when the entire Midas operation was closed down by the War Production Board. The post office was closed at that time. Since 1916, the town has dwindled from 21 saloons, a town water system, a newspaper, four general stores, and several hotels and rooming houses to a ghost town hamlet which booms only during the annual Nevada chuckar and mule deer hunting seasons.

Photograph 3. - Midas, the once booming gold camp tucked under the slopes and escarpments of the Snowstorm Mountains on the north side of Squaw Valley, as it appears today.

FIELD PARTY PHOTO 6-791-11



Two large mines, the Riley and Getchell, have been developed in the Potosi Mining District of the Osgood Mountains, to exploit the scheelite tungsten and gold-bearing ores there. The Getchell mine was located by two prospectors in 1934, and was acquired in 1935 by George Wingfield and Noble Getchell, prominent Nevada mining men. At first, the mine was operated primarily for extraction of its gold oxide ores. During World War II, however, gold mining was dropped, and operations were concentrated upon tungsten ores.

Research toward improved methods of gold extraction was continued during World War II and the interim period between that war and the Korean War. However, not all the gold extraction problems were solved by the time of the latter conflict, when emphasis was again focused upon tungsten production. During this time, the Getchell Mine ranked third in the United States in tungsten production.

With the withdrawal of the Government tungsten purchase program in December 1957, Getchell closed the tungsten operations, but continued limited exploration work in the gold ores section of the property. In 1960, after the death of the two principal owners, the mine was taken over by the Goldfield Consolidated Mining Company. In October 1961 this company embarked upon an extensive rebuilding and improvement program, aimed at full development of the mine's gold-producing potential. At the present time, the property ranks as one of the principal gold producers of the United States. (See photograph 4.)

Photograph 4. - Getchell mining operations, Osgood Mountains, 1964, looking east across Kelly Creek toward the Snowstorm Mountains (left background).

FIELD PARTY PHOTO 6-839-5



The Riley Tungsten mine, immediately south of the Getchell property, was developed in 1942 by E. J. Riley, who sold it in 1945 to the U. S. Vanadium Corporation.

Presently, an extensive gold mining operation is being developed in the old Lynn Mining District in the Tuscaroras. Also, barite ore from large deposits on the western slope of the same range is being processed in the newly completed mill at Dunphy.

The first primitive automobile road through the sub-basin was pieced together in 1913 from sections of the old emigrant wagon route, largely unused after 1870, and abandoned stretches (1901-1903) of the original Central Pacific roadbed from Valmy to Comus. This automobile road was known as U. S. Route 1 in Nevada, and in 1920 was designated the Victory Highway. At or just prior to this time, the stretch from Valmy to Golconda was relocated to the present Golconda Summit route.

In 1925, following the nation-wide change of highway names to numbers, the Victory Highway became U. S. Highway 40, and was paved in the 1930's (see photograph 5). Further relocation and improvement work followed in 1941-1942, and in 1960-1961 the first section of Interstate 80 in the sub-basin was completed over Golconda Summit. At this writing, the remaining sections of U. S. Highway 40 in the sub-basin are either being reconstructed to Interstate 80 standards or are scheduled for reconstruction in the near future.

Photograph 5. - U.S. Highway 40 in the Twin Summit area, looking east toward the crest of Emigrant Pass. On the left may be seen a remnant of the old Victory Highway, first located across this pass in the early 1920's. The California Emigrant Trail traversed down Emigrant Canyon to the right, passing by the Upper and Lower Emigrant Springs, marked by the two clumps of trees in the distance. The lower springs became the site of Primeaux Station after the construction of the first auto highway in 1920 and shortly thereafter. The disastrous dry-mantle flood of August 12, 1941, swept down the draw in the left middle distance and across the highway, trapping two automobiles and carrying them down Emigrant Canyon. One man was drowned.

FIELD PARTY PHOTO 6-788-4



The first organized effort toward the conservation and management of the soil, vegetal, and water resources of the sub-basin began in 1935. At that time the Winnemucca Grazing District, under the Division of Grazing - now the Bureau of Land Management - in the Department of the Interior, was established to manage the national land reserve (public domain) lands.

Three soil conservation districts, Humboldt River, Owyhee, and Paradise Valley, operate in the sub-basin, and provide assistance to ranch operators in the conservation and development of the soil, water, and range resources on privately owned lands. The Humboldt River district was organized in September 1950, the Owyhee district in February 1946, and the Paradise Valley district also in February 1946.

Floods

The Battle Mountain Sub-Basin has been subjected to recurrent periods of flooding and high water. The earliest recorded flood year along the Humboldt main stem was December 1861-January 1862. However, since this flood was just prior to the earliest period of settlement in the middle reaches of the Humboldt Basin, there are no known records of damage.

For further information on the history of floods and high water periods in the sub-basin, the reader is referred to the section on flood damage.

Fires

The plant and soil resources of several portions of the Battle Mountain Sub-Basin have been seriously damaged by fire. Since 1951, the earliest date of recorded fire occurrence in this sub-basin, 14 fires have been large and severe enough to be significant causative agents of watershed damage (see photograph 6). Most of these have occurred on upper Rock Creek and its tributaries. However, the largest and most destructive fire, the July 1957 Macks Creek Fire, started on a tributary of Boulder Creek. It was lightning-caused, and before being controlled had burned a 29,600 acre scar, which will not soon be eradicated, on the Tuscarora Range watersheds between Boulder Creek and Maggie Creek.

PREVIOUS STUDIES

A dam site on lower Rock Creek was investigated and mapped by the State Engineer's office prior to 1919. Since that date this dam site has been considered by various groups for flood protection, recreational purposes, and irrigation water storage; however, no formal reports have been made.

Technical reports covering limited or specialized fields have been made at various times in the sub-basin. Their titles are listed in the References section of this report.



Photograph 6. - Removal of sagebrush-perennial grass cover by the 800-acre Upper Clover Valley Fire of October 1955, as seen in 1964. Although this fire occurred almost 10 years ago, it has placed a scar on the Evans Creek Watershed which will not soon be healed or erased.

FIELD PARTY PHOTO 6-837-12

GENERAL SUB-BASIN CHARACTERISTICS

Battle Mountain Sub-Basin is in the north central part of the Humboldt Basin. It lies in portions of four counties; Elko, Eureka, Lander and Humboldt. The area contains about 1,753,000 acres, and includes the Humboldt bottomland between Palisade and Comus and the drainages north of the river from the Osgood Mountains to the Tuscarora Mountains. Whirlwind Valley and other short drainages south of the river are also included.

The Tuscarora Mountains form the east boundary, with crest elevations of about 7,000 feet. The Osgood Mountains are the west boundary, having crest elevations of about 6,000 feet. An east-west spur of the Tuscarora Mountains, and the Snowstorm Mountains, form the northern boundary; this spur crests between 6,000 and 7,000 feet. All these ranges have peaks over 8,000 feet in elevation.

Geology

Published reports and maps, showing the geology of the bedrock and valley fill, are available which cover portions of the sub-basin. Their titles are listed in the References section of this report.

In the western, southern and southeastern parts of the sub-basin, the consolidated rock outcrops include chert, argillite, slate, shale, quartzite, greenstone, limestone, sandstone, dolomite, grit, conglomerate, phyllitic shale, hornfels, and schist. Granitic intrusive masses occur. They are principally of granodiorite but include quartz monzonite,

diorite, and some gabbro.

Erosion of shale or limestone produces fine-grained sediments, while deposits derived from quartzite or chert may contain an abundance of coarse-grained sand, gravel, cobbles and boulders.

In the central and northeastern portions of the sub-basin, exposed rocks are dominantly volcanic, including rhyolite, andesite, tuffs, and other fragmental volcanic rocks. Consolidated rocks, such as quartzite and chert, underlie the volcanic rocks, and intrusive masses occur, such as granodiorite. These volcanic rocks also occur at scattered locations throughout the remainder of the sub-basin. Some of the flows are vesicular and have columnar jointing. (See photograph 7.)

Volcanic rocks have a wide range of resistance to weathering and erosion, and soils of varying texture and type are formed from them. Although fine-grained volcanic rocks tend to break down into fine-grained materials, glassy or tuffaceous rhyolitic flows weather more rapidly than massive rhyolite flows, and fine-grained dense basalts are perhaps most resistant. Granitic rocks weather to form arkosic detritus which contains an abundance of feldspar or clay and quartz. If reworked by stream action on alluvial fans or river flood plains, finer-grained clay and less resistant feldspar may be separated, and sandy alluvial deposits formed.

Photograph 7. - Massive rhyolitic lava flows form prominent rimrock along the Snowstorm Mountains, northwest side of Clover Valley.

FIELD PARTY PHOTO 6-785-12



Most of the mountain ranges trend north or northeast, and were formed by faulting, which elevated and often tilted mountain blocks or down-dropped valleys. Clover Valley, between Squaw and Kelly Creek Valleys, appears to be formed by down-block movement.

The Humboldt River flows westerly through a channel with a well-developed meander belt. Generally the flood plain of the river merges gradually with adjacent valley floors and alluvial fan slopes without an apparent break in gradient. Low terraces present in several areas are not readily discernible. Most of the alluvial fans bordering the Humboldt River are very broad, smooth, and gently sloping. Many alluvial fans, near mountain fronts, are quite steep, but short and convex. Alluvial deposits along major streams are mostly unconsolidated. They include fluvial and lacustrine deposits and alluvial fans.

Partially consolidated alluvium, lake sediments and volcanic materials may underlie the unconsolidated alluvium. Pediments or erosional surfaces largely developed on substrata or bedrock are often mantled by a thin, gravelly veneer, and outcrop along the margins of valleys.

Fluvial deposits in Kelly Creek and Boulder Valleys are braided with interconnecting channels around numerous alluvial islands. Braided streams are associated with aggrading or formerly aggrading streams, although this may not necessarily be an indication of such a condition. These deposits consist of silt and fine-grained sand interbedded with well-sorted sand and gravel.

Relatively undissected possibly fluvial valley alluvium consisting of silty and clayey beds, interbedded with sandy and gravelly layers, also occur in Kelly Creek and Boulder Valleys. In Boulder Valley older alluvium, dissected by incipient drainage, occurs as slightly elevated knolls which are surrounded by stream alluvium. Silty and clayey thin-bedded lake deposits crop out in Kelly Creek Valley, and very faint remnants of shore line features are present. Lake sediments are deflated in some areas and dunes of silty fine-grained sand partially stabilized by vegetation also occur. Dust-sized particles are blown away by the wind and often carried long distances.

In the vicinity of Battle Mountain possible clayey lake deposits are buried by 50 to 100 feet of later fluvial deposits. Around Dunphy, other possible clayey lake deposits are more deeply buried.

Some alluvial fans are presently aggrading. Coarser detritus is deposited nearer the mouth of a canyon or wash on the uppermost part of fans, while finer-grained materials are transported farther down the sides of the fans.

The tops of alluvial fans may be entrenched by erosion in at least four ways: (1) down-cutting of canyons or washes above the fans by channel erosion; (2) lowering of base levels from stream down-cutting below the fans; (3) increase in volume of stream discharge; and (4) structural movement, including upliftment of the fans or down-faulting of the ranges above the fans. Fanhead entrenchment would prevent aggradation on the upper part of fans, and allow degradation or erosion to commence on the upper part, while aggradation would continue along the lower margin of the entrenchment.

Older fan deposits are commonly covered by one and one-half feet or so of soil that has been accumulating or developing in some cases since Pre-Lahontan or early Pleistocene time. Such a soil is well developed, with a silty surface layer underlain by a prismatic clay horizon. These soils may also overlie pediments, or erosional surfaces often developed on alluvium-mantled substrata or bedrock. Possible pediments occur along the east side of Kelly Creek Valley.

Ground Water

The best gravelly aquifers in Boulder Valley may be fluvial, or, in part, reworked alluvial fan deposits. They are associated with Rock Creek, Humboldt River, and to a lesser extent with Boulder Creek. Gravelly deposits in Whirlwind Valley are associated with the Humboldt River.

Alluvial fans are important as avenues of ground water recharge, but permeable layers or stringers in alluvial fan deposits usually are not as good aquifers as the saturated stream or fluvial gravel deposits, as in Boulder and Whirlwind Valleys. If a source of ground water occurs, good aquifers can often be found about half way down the tops of fans to near their toes. Wells located high on fans with much relief, or which are entrenched by channel erosion, usually are used for pumping small amounts of water only - often because of the costly pumping involved in high lifts.

Arkosic deposits that have not been reworked by streams to remove clay or feldspar and form sandy accumulations usually are poor aquifers. Valley alluvium characteristics as aquifers may be similar to alluvial fan deposits, but existence of aquifers will depend on occurrence of saturated clean sandy or gravelly deposits. Deposits below most broad alluvial fans are too fine-grained to form good aquifers. However, if these deposits are reworked by stream action, or coarser-grained sandy or gravelly fluvial deposits are interbedded with the finer-grained deposits, good aquifers may be encountered.

Sufficient water for domestic or stock watering supplies can often be obtained from aquifers in saturated partially consolidated deposits. Saturated fine-grained lake sediments are poor aquifers; saturated coarser-grained sandy or gravelly bars or shoreline deposits may be good aquifers, if they are fairly extensive. An aquifer must be coarse-grained enough to allow water to pass between particles relatively rapidly, and must have a water source, such as an extensive subsurface reservoir.

Soils

The soils in the mountainous areas are generally moderately deep to deep, medium or stony and gravelly medium textured, and well to somewhat excessively drained. Some shallow, very gravelly and stony medium textured soils, as well as exposed bare rock, are included.

On the upland benches and terraces the soils are mostly moderately deep to deep, medium or gravelly and stony medium textured, and are well drained. There are some areas where the soil is shallow, and others that have a cemented pan at moderate depths.

The bottomland and flood plains have soils that are mostly deep, medium to moderately fine textured, and poorly to moderately well drained; salt and alkali concentrations range from none to strong. There are some well drained soils included which are shallow to moderately deep, medium and gravelly medium textured. (See Soils Description, Appendix I.)

Precipitation

Average annual precipitation on the irrigated land in the sub-basin is estimated to vary from six to seven inches along the Humboldt River, between Comus and Beowawe, and is approximately nine inches in Squaw Valley, on Rock Creek.

In the higher elevations, the precipitation is estimated to be 25 inches in the Tuscarora Mountains (over 8,000 feet) and 20 inches in the Snowstorm and Osgood Mountains (over 8,000 feet).

Average annual precipitation at points in and adjacent to the sub-basin, as determined from the U. S. Weather Bureau records, is as follows:

<u>Station</u>	<u>Elevation</u>	<u>Years of record</u>	<u>Average annual precipitation (inches)</u>	<u>Extrapolated annual precipitation (inches)</u>
Battle Mountain	4,513	93	6.6	----
Beowawe	4,695	92	6.5	----
Emigrant Pass	5,760	9	8.9	10.0
Palisade	4,820	24	8.7	7.4
Golconda	4,392	81	6.0	----
Tuscarora	6,000	50	13.7	----
Midas	5,200	10	9.1	11.0
Willow Creek Summit ^{1/}	6,370	10	11.1	13.0
Getchell Mine ^{1/}	6,000	4	12.9	----
Kelly Creek Ranch ^{1/}	5,000	4	9.5	----

^{1/} Storage gage.

Growing Season

Climate in the sub-basin is arid, with only a slight variance in average annual temperatures along the Humboldt bottomland between Comus and Beowawe (48 to 49 degrees F). The length of growing season (28 degrees F) in this area is estimated to average about 125 days. In the vicinity of Squaw Valley Ranch on Rock Creek, the temperature records are too short to determine the average frost-free period. It is thought, however, that the growing season might be in the range of 90 or 100 days.

General Cover Types

Cover types in this sub-basin are perhaps as varied as any in the Humboldt Basin. They range from dense nearly pure to admixture stands of trees, shrubs, grasses, or forbs in the higher elevations to practically nothing in the low semi-playa bottomlands. Generally, however, either big sagebrush (*Artemisia tridentata*)-grass or black greasewood (*Sarcobatus vermiculatus*) predominates, occupying approximately 55 and 14 percent, respectively, of the total sub-basin area (see photographs 8 and 9). Other vegetal types found in the sub-basin are shadscale (*Atriplex confertifolia*), black sage (*Artemisia nova*), Utah juniper (*Juniperus utahensis*) (*osteosperma*), and browse-aspen (*Populus tremuloides*)-grass.

Dense stands of quaking aspen are found at the drainage heads in the higher mountains of the Tuscaroras, principally on the northern slopes. Shrub species associated with the aspen stands are snowberry (*Symphoricarpos* spp.), serviceberry (*Amelanchier* spp.), rabbitbrushes (*Chrysothamnus* spp.), western chokecherry (*Prunus virginiana demissa*), antelope bitterbrush (*Purshia tridentata*), snowbrush (*Ceanothus* spp.), and currants (*Ribes* spp.). Understory to the trees and shrubs are such grasses as Idaho fescue (*Festuca idahoensis*), Nevada bluegrass (*Poa nevadensis*), bluebunch wheatgrass (*Agropyron spicatum*), mountain brome (*Bromus marginatus*), and oniongrass (*Melica bulbosa*). The main forbs present are lupine (*Lupinus* spp.), little sunflower (*Helianthella uniflora*), arrowleaf balsamroot (*Balsamorhiza sagittata*), penstemon (*Penstemon* spp.), mulesear wyethia (*Wyethia amplexicaulis*), and mint (*Mentha* spp.). (See photograph 10.)

Photograph 8. - Big sagebrush-grass type, upland bench and terrace site, Boulder Flat, looking westerly down the Humboldt Valley toward Argenta Rim on the left and Stony Point on the right. The grass understory here is primarily cheat.

FIELD PARTY PHOTO 6-836-6





Photograph 9. - Black greasewood type, saline bottomland site, Boulder Flat at the T S Ranch, looking south toward the Argenta Rim at Dunphy.

FIELD PARTY PHOTO 6-836-9

Photograph 10. - Quaking aspen at the drainage heads, Snowstorm Mountains, northwest of Midas.

FIELD PARTY PHOTO 6-784-6





Photograph 11. - Low sage (*Artemisia arbuscula*) type, claypan bench site, head of Rodeo Creek, Boulder Flat.

FIELD PARTY PHOTO 6-836-2

At lower elevations on Rock Creek and other drainages in the sub-basin, the aspen-browse types give way to a low sage (*Artemisia arbuscula*) cover; there are few other shrubs in this cover type (see photograph 11). Grasses present are chiefly Sandberg bluegrass (*Poa secunda*), Nevada bluegrass, bottlebrush squirreltail (*Sitanion hystrix*), and bluebunch wheatgrass. A small acreage of black sage is found on Golconda Summit; associated with it are scattered plants of winterfat (*Eurotia lanata*), along with such grasses as Indian ricegrass (*Oryzopsis hymenoides*) and needle grasses (*Stipa* spp.).

A broad area of big sagebrush-grass covers the upland benches and terraces along the north boundary, and extends generally south through the heart of the sub-basin. Grasses present in this site are Sandberg bluegrass, Great Basin wildrye (*Elymus cinereus*), cheatgrass (*Bromus tectorum*), bluebunch wheatgrass, Thurber needlegrass (*Stipa thurberiana*), and bottlebrush squirreltail. However, in the lower precipitation zones, much of this range type has only a sparse grass understory. Shrubs found with the big sagebrush are spiny hopsage (*Grayia spinosa*) and littleleaf horsebrush (*Tetradymia glabrata*). Also found are such worthless forbs as pepperweed (*Lepidium fremonti*), tumbled mustard (*Sisymbrium altissimum*), princesplume (*Stanleya* spp.), and halogeton (*Halogeton glomeratus*); Russian-thistle (*Salsola (pestifer)(kali)*) is spread widely throughout this area.

Several thousand acres of range land in the upland bench and terrace site in the Antelope Creek-Squaw Valley-Willow Creek area have been successfully seeded to either crested wheatgrass (*Agropyron cristatum*) or Siberian wheatgrass (*A. sibiricum*) (see photograph 12). A 1,200-acre trial seeding of the same grass species was planted at the mouth of Macks Creek, where it discharges into Boulder Flat. For the most part, this seeding has failed, principally because of light textured soils and low precipitation.



Photograph 12. - Crested wheatgrass seedling, north of Antelope Creek. It is estimated that 400,000 acres of rangeland in this sub-basin can be seeded to improved grass species.

FIELD PARTY PHOTO

The shadscale-bud sagebrush (*Artemisia spinescens*) desert range site occurs adjacent to the flood plains or the saline-alkali bottomlands of the river. It starts as a narrow fringe to the north and west of the bottom lands on the T S Ranch, and expands into a broad flat area below the Izzenhood and Kelly Creek Ranches (see photograph 13). The same site is present south of the Humboldt River, along U. S. Highway 40 from Battle Mountain northwestward to Golconda Summit. There are only a few scattered grasses or forbs associated with the bud sage and shadscale site. Cheatgrass and bottlebrush squirrel-tail are the principal grasses present; mallow (*Malva* spp.) and princesplume are the principal forbs. Other shrubs associated with this type, particularly in the transition zones between the bottom land and the upland benches and terraces, are big sagebrush, cotton-thorn horsebrush (*Tetradymia spinosa*), black greasewood, rubber rabbitbrush (*Chrysothamnus nauseosus*), spiny hopsage, and fourwing saltbush (*Atriplex canescens*).

Next to the shadscale-budsage site, and at a slightly lower elevation, are the saline bottomland and semi-wet meadow sites. These range sites, exclusive of the cropland, occupy nearly 20 percent of the sub-basin's total area, and include the high-producing grassland range areas. Also present are the semi-playas and playas, the lowest producing range sites.

The meadow haylands consist of such valuable plants as creeping wildrye (*Elymus triticoides*), Kentucky bluegrass (*Poa pratensis*), Nevada bluegrass, timothy (*Phleum* spp.), native wild clover (*Trifolium* spp.), redtop (*Agrostis alba*), and tufted hairgrass (*Deschampsia caespitosa*), with creeping wildrye being the most prevalent and generally the highest producer. There are approximately 2,000 acres of these meadow haylands which have been planted to alfalfa.



Photograph 13. - Shadscale-bud sagebrush type, dry desert uplands site, looking north toward lower Clover Valley. There is little grass or forb understory present.

FIELD PARTY PHOTO 6-744-6

Throughout the Humboldt River bottomlands there are extensive fenced acreages of grassland used principally for pasture. Forage species present are Great Basin wildrye, alkali sacaton (*Sporobolus airoides*), creeping wildrye, saltgrass (*Distichlis stricta*), yellow sweetclover (*Melilotus officinalis*), Nevada bluegrass, and alkali bluegrass (*Poa juncifolia*). Usually Great Basin wildrye predominates, with total plant growth as high as 6,000 pounds per acre; normally these areas yield from 1,500 to 3,000 pounds per acre (see photograph 14). Associated with grasses in this area are such shrubs as rubber rabbitbrush, black greasewood, wild rose (*Rosa* spp.), currant, silver buffaloberry (*Shepherdia argentea*), and willow (*Salix* spp.). Such forbs as western yarrow (*Achillea lanulosa*), cinquefoil (*Potentilla* spp.), dandelion (*Taraxacum officinale*), thelypody (*Thelypodium* spp.) and iris (*Iris missouriensis*) are present throughout the bottomlands, but are usually restricted to the meadow hayland and pasture areas.

The remainder of the bottomlands not classified as native pasture, hay, or alfalfa is occupied by extensive areas of phreatophytic greasewood. Density and growth of the greasewood varies from scattered, stunted plants on the highly saline-alkali semi-playa areas to a thicker cover of larger plants on the more favorable sites. Shrubs found with the greasewood are rubber rabbitbrush, spiny horsebrush, spiny hopsage, and big sagebrush. Alkali seepweed (*Suaeda fruticosa*) is also present, but is usually confined to the more poorly drained semi-playa sites. In contrast, big sagebrush and rubber rabbitbrush are associated with greasewood on the better drained, less saline-alkali affected soils. The semi-playa areas have little if any vegetation as understory to the greasewood (see photograph 15). However, above the playa and semi-playa sites there are a few grasses associated with the greasewood stands; mainly Great Basin wildrye, alkali sacaton, and



Photograph 14. - Grassland type primarily used for pasture, Humboldt River bottom-land at the T S Ranch, looking south toward the Argenta Rim. Principal grass species present are Great Basin wildrye, alkali sacaton, creeping wildrye and saltgrass.

FIELD PARTY PHOTO 6-836-10

Photograph 15. - Black greasewood type, semi-playa site, northwest of Battle Mountain. Very little if any vegetation appears as understory to the greasewood in this site.

FIELD PARTY PHOTO 6-744-1



saltgrass. Thelypody, thickstem wildcabbage (*Caulanthus* spp.) and pepperweed are the principal forbs.

The only stands of Utah juniper are located in the Galena Range, along Trout and Cottonwood Creeks, as well as in the rolling foothills north and south of the Humboldt River, in lower Palisade Canyon. Associated with the juniper are such plants as big sagebrush, cheatgrass, Indian ricegrass, Sandberg bluegrass, bottlebrush squirreltail, Great Basin wildrye, and evening-primrose (*Oenothera* spp.).

A long, narrow playa extends from a few miles north of Valmy to the vicinity of the Red House Ranch at Iron Point. This relatively barren area occupies approximately 2,600 acres. Near the east end of this playa is a large hot spring. A relatively small playa is located at the lower end of Whirlwind Valley.

Along the Humboldt River, from the mouth of Palisade Canyon to the Red House Ranch, are islands and stringers of willow, principally along the natural water courses and irrigation ditches. The willow type covers an estimated 3,600 acres. Between Argenta Point and Battle Mountain, the area previously occupied by willow and other phreatophytic species has been cleared and drained, in connection with the Rye Patch Project, and the former vegetal cover is being replaced by grasses, weeds, and forbs.

Water Yield

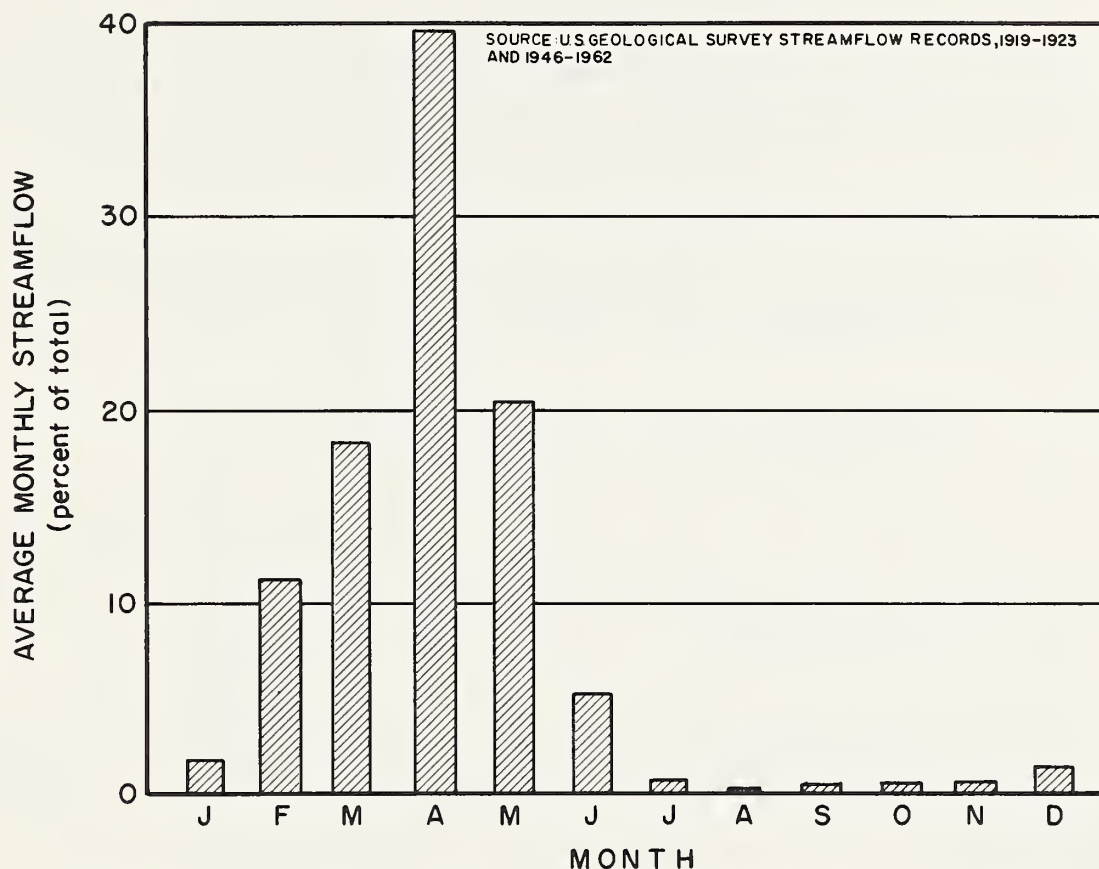
Except for flood periods, the water yield to the Humboldt River from the sub-basin is negligible compared to the flow in the river. Rock Creek is the principal drainage in the sub-basin contributing water to the Humboldt River. Snowmelt runoff usually occurs on this stream from the middle of February through May, with peaks usually in April (see figure 1). Normally, Rock Creek has no surface flow reaching the Humboldt River from June through October. Discharge extremes at the Rock Creek gaging station vary from periods of no flow to 4,800 cubic-feet per second on February 11, 1962.

The average annual flow at the Rock Creek gage for 22 years of record (1919-1923 and 1946-1962) is 23,060 acre-feet. Using a frequency curve, plotting the same years of record, the 50 percent flow is calculated to be 13,500 acre-feet, and the 80 percent frequency is 5,600 acre-feet.

Water from Kelly Creek, Izzenhood, and Boulder Flat Watersheds is used primarily by extensive acreages of phreatophytes, plus a relatively small acreage of crops; very little if any flow is contributed to the Humboldt River. The 80 percent frequency (chance) concept, as computed for previous sub-basins, has only limited value in defining the total available water supply within sub-drainages where recharge potential and ground water storage is large in comparison to expected yield. Under these conditions virtually all gross yield in excess of evapotranspiration by crops and phreatophytes finds its way into the ground water basin, and the usable water supply for such an area approaches the average annual yield, less any discharge from the ground water basin.

A study of the subsurface discharge into the Humboldt is beyond the scope of this

Figure 1. -- Annual streamflow distribution, Rock Creek gage near Battle Mountain



study. Detailed ground water studies have not been made, except for single well locations. At present, the Nevada Department of Conservation and Natural Resources is gathering data on a series of wells in and along the Humboldt bottomland, to determine ground water movement from side drainages. Also, a general description of the ground water geology of this area can be found in State of Nevada Water Resources Bulletin Number 21, Hydrology of the Lower Humboldt River Basin, Nevada, June 1963.

The following tabulation shows the comparison between the average flow and the calculated flow for a 50 percent and 80 percent frequency (50 and 80 percent chance, expected to be equaled or exceeded five or eight years out of 10) year for both the Palisade (53 years) and Comus (49 years) gaging stations.

	Palisade gage (acre-feet)	Comus gage (acre-feet)
Average	257,000	196,600
50 percent frequency	216,000	150,000
80 percent frequency	118,000	74,000

The Beowawe Geysers in Whirlwind Valley, as well as other hot springs in the sub-basin, are considered to have their source in the Humboldt River Basin; their com-

bined flow is not included in the gross water yield. In recent years investigations have been conducted to determine the suitability of the Beowawe Geysers for the production of electrical power.

There are an estimated 13 irrigation wells in the sub-basin, with capacities varying from 900 to 3,200 gallons per minute. Numerous low-capacity wells are scattered throughout the area which are used for farmstead and livestock purposes.

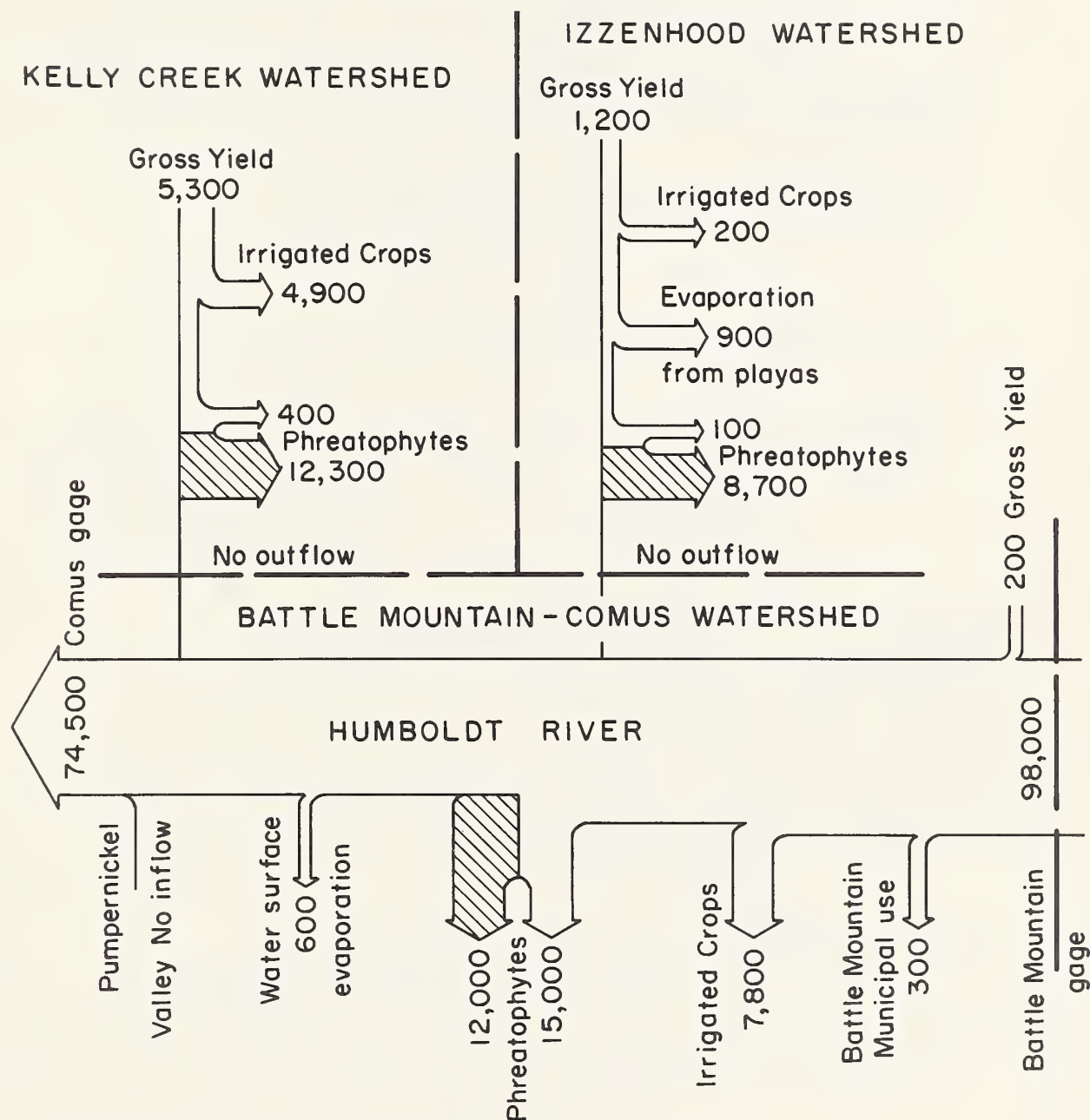
A flow diagram of gross water yields, depletions, inflow, and outflow, as determined from the water balance studies by the Field Party, is illustrated in figure 2 (see also Annual Water Balance Study - 80% Frequency (Chance), Appendix I). A water balance summary from the diagram is shown in the following tabulation:

Water Balance Summary, 80 Percent Frequency (Chance)

		<u>Acre-feet</u>
Gross Water Yield: <u>1/</u>	(1,753,000 acres)	21,500
Inflow: Humboldt River at Palisade	116,000	
Pine Creek	5,000	
Total inflow	<u>121,000</u>	121,000
Water from ground water storage <u>2/</u>		<u>56,200</u>
Total water		<u>198,700</u>
Uses and Losses:		
Irrigated crops (28,000 acres)	29,300	
Phreatophytes (213,000 acres)	91,000	
Reservoir evaporation	300	
Evaporation from playas	1,300	
Direct evaporation from water surface <u>3/</u>	2,000	
Municipal water (Battle Mountain)	300	
Total uses and losses	<u>124,200</u>	<u>124,200</u>
Discharge: Humboldt River at Comus		<u>74,500</u>

- 1/ Gross water yield, for the purpose of this study, is the estimated available water, both surface and subsurface, prior to agricultural and phreatophytic use. Generally, this water yield is estimated for a stream or streams at a point above the highest diversion for the main body of irrigated land on a flood plain of a valley.
- 2/ The estimated quantity of water used, or discharges as outflow from ground water storage in excess of water yield.
- 3/ Loss of water by direct evaporation from surface water during periods of high flow. This loss would be in addition to the evaporation associated with consumptive use by plants. The water area is generally the same as the land being flood-irrigated plus the river channel area.

Figure 2. -- Flow diagram of gross water yields, depletions, inflow, and outflow in acre-feet for watersheds in the Battle Mountain Sub-Basin for an 80% frequency (chance)




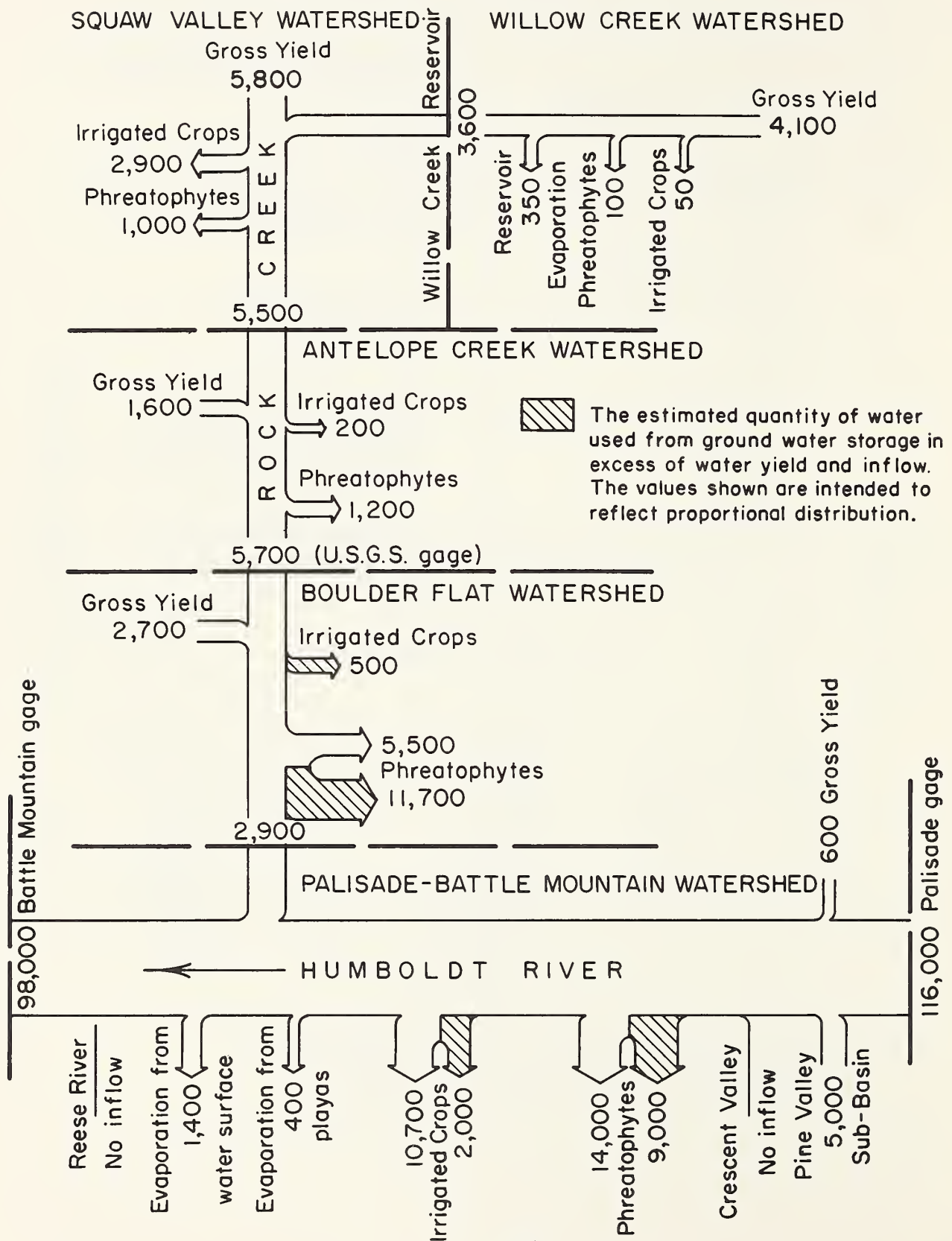
 The estimated quantity of water used from ground water storage in excess of water yield and inflow. The values shown are intended to reflect proportional distribution.

Figure 2. -- Flow diagram of gross water yields, depletions, inflow, and outflow in acre-feet for watersheds in the Battle Mountain Sub-Basin for an 80% frequency (chance) -- Continued



LAND AND WATER USE

Land Status

There are at present an estimated 113 owners of private land in the sub-basin, according to records of the Bureau of Land Management at Elko and Battle Mountain and the Soil Conservation Service at Elko and Winnemucca. Sections of Federal and private lands are intermingled in a checkerboard pattern in the southern two-thirds of the sub-basin. Included in the private land are an estimated 253,700 acres owned by the Southern Pacific Land Company.

The land status breakdown is as shown in the following tabulation:

<u>Land status</u>	<u>Square miles</u>	<u>Acres</u>	<u>% of total</u>
National Land Reserve	1,404.1	900,600	51.4
Bureau of Reclamation	93.9	58,100	3.3
Indian Colony	1.1	700	----
State and County	3.0	1,900	.1
Private	1,237.0	791,700	45.2
Total	2,739.1	1,753,000	100.0

Land Use

The national land reserve (public domain) lands are used primarily for grazing of domestic livestock. Grazing licenses are issued on the basis of spring-fall and summer range use, depending upon location and type of range. Portions of these lands also serve as a habitat for big game and other wildlife. The long-range land program of the Bureau of Land Management includes encouragement of land exchanges, in order to establish a more desirable land ownership pattern, particularly on high watershed lands. Recreation is expected to be an important phase of the Bureau of Land Management program. The Bureau's proposed recreation development program is briefly discussed in the recreation and wildlife section.

Private lands are used for the production of irrigated crops and range forage. In many instances exchange of use agreements and private land permits are granted the owners of private intermingled lands, and these areas are then administered with public lands by the Bureau of Land Management. The bulk of current grazing on national land reserve range is on community allotments, although a small number of individual allotments has been established and division of the range into individual allotments is progressing.

The acreages of land irrigated and cropland harvested vary from year to year, depending on precipitation and stream flow. Practically all the irrigated land is used to produce winter feed for livestock.

In 1935 the U. S. Bureau of Reclamation purchased seven ranches with their appurtenant water rights in the Battle Mountain area, to augment the water supply of the Rye

Patch project; one water right was purchased without land. This land, totaling 60,110 acres - 58,100 acres in this sub-basin - is at present leased by the Bureau to ranchers for pasture. Of this total, about 32,180 acres had decreed water rights for 48,770 acre-feet of water.

Water Rights

Most of the water rights were established by the George A. Bartlett Decree of 1931. There are some rights, however, that were established by the Edwards Decree of 1935, and others by permits from the State Engineer's office. In general, the decreed rights provide for a flow of 0.81 c.f.s. per 100 acres of decreed land, or at proportional rates, for the periods indicated in the tabulation. The following tabulation shows the present acre-feet of decreed water and the acres of decreed land in the sub-basin:

<u>Class of land</u>		<u>Dates of use</u>	<u>Decreed water</u> (acre-feet)	<u>Decreed land</u> (acres)
Harvest	(A)	3/15-9/15	46,730	14,790
Meadow pasture	(B)	3/15-6/13	24,390	16,260
Diversified pasture	(C)	3/15-4/28	19,120	25,500
Total			90,240	56,550

There are permitted and vested water rights, totaling about 8,000 acres, which are not included in this tabulation. These rights cover water used from irrigation wells, springs in the vicinity of the Izzenhood Ranch, and Warm Springs (Hot Springs Ranch) as well as water from surface flow along drainages of Kelly and Evans Creeks.

The 28,000 acres of land being irrigated, as shown in the water balance summary, are an estimation of the land used to produce hay and pasture during an 80 percent frequency (chance) flow year, and would therefore differ considerably from the total acreage of decreed land with water rights. The total acres irrigated are primarily controlled by the quantity of water available and priority of water use.

Water Use

The annual water balance studies made by the Field Party show that during an 80 percent frequency (chance) flow year the estimated annual water used by phreatophytic plant growth, plus irrigation and municipal uses and surface water evaporation, are as follows:

	<u>Acres</u>	<u>Water use acre-feet</u>
Irrigated crops	28,000	29,300
Phreatophytes	213,000	91,000
Reservoir evaporation	-----	300
Evaporation from playas	-----	1,300
Direct evaporation from water surface	-----	2,000
Municipal water	-----	300
Total		<u>124,200</u>

Part of the water used by phreatophytes and pumped for irrigated crops comes from ground water storage. This water, estimated to be 56,200 acre-feet, is included in the 91,000 and 29,300 acre-feet figures shown in the preceding tabulation. The ground water storage, which is being drawn upon during low water-yielding years, is recharged from precipitation and runoff in more favorable water years.

There are two storage reservoirs in the sub-basin. One, the Willow Creek Reservoir, has a capacity of 18,000 acre-feet, and is used to store water for the irrigation of cropland on the Squaw Valley Ranch. The other is a low-capacity storage reservoir for the Izzenhood Ranch. Water from wells, springs, and reservoirs is used to irrigate about 3,000 acres of cropland planted to alfalfa or alfalfa-grass (see photograph 16). Surface water, diverted from stream channels, is used to irrigate meadow hay and pasture lands, as well as a small acreage of alfalfa.

Photograph 16. - One of the several large irrigation wells present in this sub-basin. T S Ranch, five miles west of Dunphy. The well is used to irrigate alfalfa fields when irrigation water from the Humboldt River is inadequate because of low flow.

S.C.S. PHOTO 6-617-9





Photograph 17. - Nomad alfalfa, Horseshoe Ranch, near Beowawe, Nevada, showing border irrigation. Water table fluctuates from three to 10 feet. Stand is approximately six years old and is producing from four to five tons per acre. Stand appears to be thickening.

FIELD PARTY PHOTO 6-839-8

Irrigation Methods

There is a limited number of improved irrigation developments in the sub-basin. These consist of land leveling, land smoothing, drainage, diversion structures, spreader ditches, irrigation wells, and storage reservoirs.

Most of the cropland that has been improved is irrigated by the border method (see photograph 17). A water supply has been developed for these lands, either to satisfy the total plant requirement, or to supplement surface flow for late season irrigation.

The meadow lands are irrigated principally by a semi-controlled type of wild flooding. Water supplies from stream flow vary widely throughout the irrigation season, which makes the regulation of water difficult. During the high runoff period, streamflow is either diverted or floods over meadow and pasture lands naturally; ditches are used to aid in obtaining a more uniform distribution of water over the land.

THE AGRICULTURAL INDUSTRY

Battle Mountain Sub-Basin contains portions of four counties - Elko, Eureka, Humboldt and Lander. Data presented here were obtained from aerial photos, conservation ranch plans, University of Nevada bulletins, U.S. Census of Agriculture and individual ranch observations. Trends as reported in the Census of Agriculture for the four counties were also considered.

Ranch Characteristics

Number of ranches in Battle Mountain Sub-Basin has been decreasing in past years, while ranch size has increased. At present, there are 18 livestock ranch operations within the sub-basin, 13 of which are headquartered there. All 18 ranches are cattle operations; however, three of the ranches also have a large number of sheep. These ranches vary in size from about 500 to 200,000 acres, plus licensed grazing on public land. Some ranches are completely within the sub-basin, while others have holdings elsewhere.

Distribution of private ranch land acreages in the sub-basin is as follows:

<u>Thousand acres</u>	<u>Number of ranches</u>
2 or less	8
2.1 to 20	4
20.1 to 60	5
60.1 and over	1
Total	<u>18</u>

In addition to private range, pasture, and cropland, all commercial ranches in the area hold licenses to graze livestock on Federal rangeland. Ranches in the sub-basin are about 70 percent owner-operated, the remaining 30 percent being operated by part-owners, managers, or tenants. Fourteen of the 18 ranches are commercial-type operations deriving the major portion of their income from the production of livestock and livestock products. The remaining four are part-time operations, running a small number of cattle.

Cattle, calves, sheep, lambs, and wool are the major agricultural exports from the sub-basin. About 99 percent of all agricultural products sold are from these sources.

Ranch expenditures, both capital and operating, have been on the increase. Costs of feed for livestock, cost of mechanization, gas and other petroleum expenses have been the major sources of this increase. The higher cost of feed has been primarily brought about by increasing feed prices, while greater gas and other petroleum costs have been principally through increased consumption as a result of farm mechanization.

Crop Production

Hay provides 25 to 30 percent of the feed requirement for livestock in the sub-basin. Grazing on crop aftermath and adjacent dry and irrigated pasture furnishes from 15 to 20 percent of the feed requirement, while the remaining 50 to 60 percent is harvested from Federal and intermingled private spring-fall and summer range land.

About 28,000 acres are harvested for hay during an 80 percent frequency (chance) year. During greater deficiency water years, this may be as low as 10 to 15 thousand acres. Along the fringes of the hay land and on the flood plains, an additional 32,000 acres receive wild flooding during high water years, or subirrigation from ground water. A large portion of this area has a Class C water right, and has a cover of both beneficial

and nonbeneficial phreatophytes. This land is used primarily as spring-fall pasture for cattle and horses.

In 1963, 3,300 acres of alfalfa and alfalfa-grass were harvested for hay, of which 1,500 acres were in relatively new stands. In the sub-basin, alfalfa yields from three to six tons per acre from two to three cuttings, depending principally upon soils, available moisture, and length of growing season (see photograph 18). Average yield for this crop is about four tons per acre. Of the total 3,300 acres of alfalfa, 3,000 acres have a full supply of irrigation water; the remaining 300 acres are irrigated periodically with surface flow. An additional 300 acres have been cleared for planting to alfalfa in 1964. No stands of improved grasses, or legumes other than alfalfa, are being grown in the sub-basin at the present time.

Of the 28,000 acres of hay land, 24,700 are in meadow hay, and receive semi-wild flood irrigations. This hay land yields from .75 to two tons per acre, with an average of about 1.25 tons. (See photograph 19.)

Alfalfa and meadow hay lands yield from one-half to one A.U.M. of aftermath grazing per acre, which is generally utilized in the fall after cattle come off the range. Wet meadow pastures yield from two to four A.U.M. 's per acre annually.

Grain is not grown as a cash crop; however, it is used as a nurse crop for new plantings of alfalfa.

Photograph 18. - Hay fields, T S Ranch, Boulder Flat, 10 miles north of Dunphy Ranch, looking south. This field is border-irrigated from two irrigation wells, and has produced from 5.5 to 6.5 tons per acre from three to four cuttings.

FIELD PARTY PHOTO 6-538-3





Photograph 19. - Creeping wildrye meadow hayland, near Beowawe, Nevada, which produces approximately two tons per acre.

S.C.S. PHOTO 6-723-6

Livestock Production

During the first thirty years of this century, many sheep grazed on sub-basin rangeland. In the 1930's sheep numbers decreased sharply; the sheep industry has continued to decrease in importance. At present there are no operations producing sheep as their principal enterprise, and only three major operators have combined cattle and sheep operations. These three hold grazing licenses for approximately 17,000 head of sheep on the public ranges of the sub-basin. Sheep ranchers graze their flocks throughout the year on Federal and intermingled private rangeland. At lambing time the sheep are gathered at designated sites on the range to be fed and closely observed. At present, the saleable lamb crop is about 80 percent, based on numbers of mature ewes. Some lambs have sufficient finish to go directly to packers, while the remainder are fed out in nearby States.

Numbers of cattle and calves on ranches in Battle Mountain Sub-Basin were at an all time high at the start of the Twentieth Century. Cattle numbers decreased from that time until the present; there are now an estimated 16,500 head of cattle on 18 sub-basin ranches (see photograph 20). They are distributed by size of herd as follows:

<u>Number of cattle</u>	<u>Number of ranches</u>
199 or less	4
200 to 999	8
1,000 and over	6
Total	<u>18</u>



Photograph 20 - Hereford cattle at a saltground, Snowstorm Mountains, northwest of Midas.

FIELD PARTY PHOTO 6-784-8

Cows are bred so as to calve mostly in February or March, although some calves are born throughout the year. The calf crop varies from 50 to 95 percent, averaging about 75 percent. There does not seem to be a correlation between size of enterprise and percent calf crop. Some ranches are realizing high calf crops through improved management.

Weaning weights of calves in the area range from 250 to 400 pounds, depending upon date of birth, available forage, and hereditary growth potential, and average about 325 pounds.

Livestock Marketing

An estimated 8,000 head of cattle and calves were shipped annually from Battle Mountain Sub-Basin over the past few years. Major classes and percentages generally shipped were as follows: Steers, 30 percent; cows, 25 percent; and mixed calves, 25 percent.

The majority of livestock is contracted for sale. Cows and bulls are often sold through auction or to local buyers; buyers generally pay all shipping costs.

California packers and feeders receive about 50 percent of the cattle shipped. Idaho is second, receiving about 20 percent of the exports. About 18 percent remain in Nevada but are shipped to other areas. The remaining 12 percent are shipped to other western States.

A study by the University of Nevada shows that California market demands for all in-shipments of cattle have grown over a 20-year period (1940-1959) at 3.75 percent per year, but Nevada shipments to California over the same period have increased only 2.34 percent per year for all classes. If post-war years (1947 to 1959) are evaluated, there has been only a slight increase in numbers shipped for combined slaughter and stocker-feeder purposes. The number of cattle shipped to California for immediate slaughter has decreased, mainly through changes in grade demanded by California packers.

Transportation

Transportation facilities available to Battle Mountain Sub-Basin ranches are adequate. Two interstate railroads, Southern Pacific and Western Pacific, serve the area and provide daily schedules to the west coast and to Ogden, Salt Lake City and points east (see photograph 21). Both railroads offer livestock transportation service, with loading facilities at Battle Mountain, North Battle Mountain, Beowawe, Valmy, and Golconda.

Trucks transport approximately 75 percent of the cattle leaving the sub-basin, while 25 percent are shipped by rail. Several motor freight common carriers maintain terminals in Elko and Winnemucca and provide interstate service to all parts of the nation. Some local carriers provide intrastate service. Idaho and California truck carriers also transport livestock from the sub-basin.

Transcontinental U.S. Highway 40 (Interstate 80) links the sub-basin with all eastern and western points, and U.S. Highway 95 at Winnemucca provides access to southern Oregon and Idaho. Nevada Highway 18 links the northern portion of the sub-basin with U.S. Highway 40. During good weather, numerous other roads and truck trails provide access to most parts of the sub-basin.

Photograph 21. - Two interstate railroads, Southern Pacific and Western Pacific, serve the sub-basin area. Shown here is the Western Pacific main line at Dunphy, looking southeast toward Beowawe. (Between Wells (Alazon) and Winnemucca (Weso), under a joint track agreement between the two railroads, the Western Pacific track is used by eastbound traffic, the Southern Pacific by traffic westbound.)

FIELD PARTY PHOTO



WATER-RELATED PROBLEMS IN THE SUB-BASIN

Agricultural Water Management

Seasonal Distribution of Water

Snowmelt runoff from Rock Creek usually occurs from February through May, with peak flows in April. Along the Humboldt, runoff usually occurs from February through July, with peak flows in June. Time and quantity of flow in streams throughout the area can vary considerably, however, depending upon weather conditions.

Lands irrigated from direct diversion of surface flow, for the most part, receive but one irrigation during the spring runoff (see photograph 22). The exception to this is the land irrigated from reservoirs, wells, and springs.

Generally, the conditions resulting from short seasonal flow favor the growing of low-quality forage plants which tolerate wide extremes in soil moisture over extensive periods of time.



Photograph 22. - Semi-controlled wild flooding, meadow haylands, T S Ranch, near main ranch headquarters, looking west.

FIELD PARTY PHOTO 6-838-8

Soils

The principal soils problems on irrigated land are high water table, poor drainage, and salt and alkali concentrations. These problems usually occur in the Alluvial and Solonetz Soils which are found on the flatter slopes in the valley bottoms. (See photograph 23.)

Ground cover density reduction on the range areas, particularly on the upland bench and terrace and intermediate mountain slope sites, has led to considerable topsoil loss through sheet erosion. This has resulted in gravel-paved surfaces, and loss of plant litter and soil fertility.



Photograph 23. - High saline-alkali soils, along Highway 40, Dunphy Ranch. Shows an attempt to reclaim these lands by deep furrow planting, on level land, and irrigating down the furrows. Species planted were tall wheatgrass (*Agropyron elongatum*), and yellow sweetclover (*Melilotus officinalis*). Prior to planting, 3.5 tons of gypsum were applied per acre.

S.C.S. PHOTO 6-538-5

Seepage Loss

Water loss from surface to ground water was observed to be moderately high in a few ditches and stream channels flowing over alluvial fans. The amount of cropland affected by this condition is relatively small; however, during years with low precipitation this seepage loss decreases the acreage which can be irrigated.

Drainage

In some areas, salt and alkali concentrations and high water table limit the type of crops that can be grown, and the crop yields. Most of the trouble spots are caused by re-turning ground water rising to or close to the surface.

Irrigation Efficiency

On-the-farm irrigation efficiency (amount of water required to bring the soil in the root zone to field capacity, divided by the amount of water applied) is variable throughout the sub-basin. On fields that have been leveled or smoothed and irrigated with water from wells, reservoirs, or springs, the efficiency is estimated to range from 20 to 50 percent. Fields that are flood-irrigated from surface flow usually obtain less efficient water use; estimated to be 20 percent or less.

Control of Water

Almost 90 percent of the cropland is irrigated only during the spring runoff period. It is difficult to increase crop yields and improve the type of forage grown without the development of a late-season water supply. Controlled diversions and additional field ditches would also be needed along the Humboldt bottomland, and pipe lines, ditch lining, turnouts, and drop structures would be needed in other locations.

Flood Damage

The Battle Mountain Sub-Basin, in common with the other Humboldt sub-basins, has been subjected to many periods of flooding or high water. Both flood types - wet-mantle and dry-mantle - have been destructive, in terms of recorded flood, erosion, and sediment damage.

The wet-mantle flood results from the complete saturation of the soil mantle, to the point of overland flow. This condition is brought about by extended periods of warm winter rain, rain-on-snow or frozen ground during the winter months, or the rapid melting of abnormal snow accumulations in the spring.

The dry-mantle flood is primarily a summer occurrence, resulting from relatively short periods of heavy rain from summer thunderstorms on dry soils with a thin or depleted vegetal cover, whereby the soil mantle is only superficially wetted by the beating rain. Most of the sudden downpour then runs off in the form of overland flows. The dry-mantle type occurs less frequently along the Humboldt, and is usually confined to the stream sources on the higher watersheds, although it often can (and does) cause severe localized downstream damage.

Wet-Mantle Floods

January - May 1881. - Sustained periods of warm rain occurred in late January and early February on heavy winter snowpacks at the lower elevations. Not much runoff emanated from the higher country, as rain turned to snow there. All the reservoir dams, constructed less than a month previously on Kelly Creek and in Squaw Valley by the English-owned Nevada Land and Livestock Company to irrigate newly reclaimed lands planted to alfalfa, were completely destroyed. A loss of \$35,000 to \$45,000 was incurred thereby. So far as is known, these structures were not rebuilt.

May - June 1884. - Melting of abnormally heavy snow accumulations from the winter of 1883-1884, plus periods of sustained spring rains, caused the greatest overall flooding throughout the Humboldt Basin since 1861-1862. By June 5 the Battle Mountain basin, from Beowawe to Battle Mountain, had become one vast lake. Many miles of Central Pacific trackage between those points were covered with water. To protect against washouts, the railroad stationed men at intervals along the tracks through this section. The road bridge over the Humboldt from Battle Mountain to what is now North Battle Mountain was so badly washed it had to be closed, and was subsequently rebuilt.

March 7 - June 5, 1890. - The flood period resulted from the breakup of the disastrous "Hard Winter" of 1889-1890, also known as the "Winter of White Death". A large irrigation diversion structure across the Humboldt at Argenta on the T S Ranch was washed out, among others. Heavy cattle losses were incurred from miring, drowning, starvation, etc., all along the Humboldt. Cattle losses (98 percent) from this flood period and from starvation on the range during the preceding winter months brought about the liquidation of the Nevada Land and Livestock Company.

March 6 - April 21, 1907. - Heavy rains on a large winter snowpack in the lower Humboldt Basin below Battle Mountain, as well as in western Nevada, caused flooding in the middle and lower Humboldt Basin. Some miring and drowning of livestock occurred below Battle Mountain. One man and his horse were drowned crossing the Humboldt in the vicinity of Stonehouse Station while attempting to move cattle to higher ground.

February 18 - March 15, 1910. - Practically a system-wide flooding of the Humboldt and other eastern and southern Nevada streams, brought on by extended periods of warm rain on heavy snow or frozen ground. As was the case in 1884, the Humboldt Basin between Beowawe and Battle Mountain became a large lake. In March 1910, the river was described as being four to five miles wide in the vicinity of Dunphy and Boulder Flats. Farther west, Kelly Creek was said to be one and one-half miles wide at its junction with the Humboldt. At Battle Mountain, Reese River formed a large lake behind the Southern Pacific grade, flooding portions of the town. It finally washed through the railroad grade in three places.

Passenger and freight traffic on the Southern Pacific was completely disrupted for 10 days (February 28-March 9) by washouts between Carlin and Battle Mountain. During at least part of this period, as many as seven westbound passenger trains were stalled in the Palisade yards, and eastward toward Carlin, while the same number of eastbound trains terminated at Winnemucca or Battle Mountain, on the west side of the damaged section. The Southern Pacific used 500 men and two trainloads of pilings to repair a total 1,300 feet of washed out grade and 16 bridges between Palisade and Battle Mountain.

The newly constructed Western Pacific Railroad between Carlin and Winnemucca suffered extremely heavy damage. In addition to bad washouts in lower Palisade Canyon, a seven-mile stretch of new roadbed and trackage west of Beowawe was practically washed away. At least 12 Western Pacific bridges between Carlin and Winnemucca were destroyed or greatly weakened. The Western Pacific damage was so severe that on March 16 arrangements were made to use Southern Pacific trackage between Beowawe and Elko for about four months.

As no through passenger or freight service had at that time been instituted on the Western Pacific, there was no immediate effect on such services. However, the inaugural opening of the entire line for through traffic - originally scheduled for the early spring of 1910 - was delayed until June of that year, because of the extensive rebuilding program necessary on this portion of the railroad.

April 3 - May 1, 1942. - The heaviest flood along the upper and middle Humboldt

valley since 1910, which was triggered by heavy warm rains accompanied by strong south winds on April 3 and 4. Rapid melting of unusually deep snow accumulations on the lower slopes resulted.

A landslide in Palisade Canyon caused the Humboldt to flood both the Western Pacific and Southern Pacific grades at Palisade. Fills on both railroads in lower Palisade Canyon were badly washed, necessitating heavy reinforcement.

At Beowawe, the Humboldt floodwaters ran several feet deep in the streets. Many residences were flooded to second floor levels, and ingress and egress was possible only by rowboats. Along the Humboldt above and below Battle Mountain, the Horseshoe, the T S, the Russell 25 (now the Jenkins 25), the Licking and Blossom Ranches were inundated. Battle Mountain was cut off from North Battle Mountain by the washout of the approach road and bridge over the Humboldt. All tight dams on the Humboldt from Elko to Rye Patch Reservoir were dynamited, to relieve flood pressures. Extensive damage was inflicted on bridges, roads, irrigation structures, ranch buildings, as well as erosion damage to cropland and range areas.

January 21-27, 1943. - Flood conditions were brought on by a driving rain storm which lashed all of Nevada and eastern California on January 20-21, melting the winter snow accumulations. Beowawe was again flooded by the Humboldt River waters, but not as extensively as in 1942. The same ranches in the Dunphy-Battle Mountain basin which flooded in 1942 were again flooded, but not so heavily. However, it was necessary to move livestock to higher ground.

February - May 1952. - A system-wide flooding of the Humboldt, resulting from the melting of the enormous masses of snow accumulated during the winter of 1951-1952. Beowawe was flooded (see Flood Damage, Reese River Sub-Basin Report). Near Dunphy, flooding Rock Creek and the Humboldt stranded 20,000 sheep and 8,000 cattle, because of the washout of several bridges, which prevented the livestock from being driven to higher ground.

Above Squaw Valley on upper Rock Creek, the water in the large reservoir on Willow Creek reached within 20 inches of the dam crest, but did not overflow. As in 1942, the road between Battle Mountain and North Battle Mountain washed out in several places, but the bridge over the Humboldt held. The hay meadows of the Licking, Blossom, and other ranches near Battle Mountain were extensively flooded, resulting in subsequent crop production losses. Sedimentation was heavy on some fields of the Horseshoe, Dunphy and Licking ranches. Slow orders were in effect on both Southern Pacific and Western Pacific train movements from Palisade to Iron Point, but there are no records of any suspension of service. All along the Humboldt, tight dams and diversion structures not already destroyed by the floodwaters were blown out.

February 9-13, 1962. - Most of the damage in the sub-basin resulting from this period of prolonged rain on snow or frozen ground was confined to sheet and gully erosion, channel scouring, sedimentation, and the miring or stranding of livestock in the Beowawe-Dunphy-Argenta area. Approximately 1,500 cattle were lost in the Battle Mountain Basin



Photograph 24. - Flooding of Humboldt meadowlands, Horseshoe Ranch, Beowawe, February 12, 1962.

S.C.S. PHOTO 6-659-5

through malnutrition and disease. Many diversions and irrigation structures throughout the sub-basin were damaged or destroyed. (See photograph 24.)

Dry-Mantle Floods

August 12-16, 1941. - The only recorded instance of damage from this flood type which has been found. Torrential summer rainstorms during this period all along the Humboldt resulted in localized, brief, but heavy flooding. The area most heavily affected was the stretch from Carlin to Beowawe. On the afternoon of August 12, a flash flood across U. S. Highway 40 just west of Primeaux Station on Emigrant Pass caught two autos containing six people. A Greyhound bus just missed being caught at the same location. (See photograph 5.)

Both cars were swept down Emigrant Canyon toward the Humboldt; one man was drowned. The Western Pacific tracks were damaged in the vicinity of Harney Station from this same freshet. Some delay to train movements resulted.

More detailed information on both types of floods affecting the sub-basin over the years may be found in the Field Party's Chronology of Flood Years and High Water Years.

Vegetal Conditions

Range and Watershed

Most of the sub-basin range lands are producing far below their potential. Watershed conditions are deteriorated, particularly along Rock, Willow, and Antelope Creeks. Only 25 percent of the area is in the medium and fairly high forage production classes; the remaining 75 percent is in the low forage production class. (See table 1, and photographs 25 and 26.)



*Photograph 25. - Big sagebrush-grass range in low forage production class, upland bench and terrace site north of Gravelly Ford on the Humboldt, looking south toward Crescent Valley and the Shoshone Range. The former perennial grass understory to the big sagebrush has here been replaced by fanweed (*Lepidium perfoliatum*) and cheatgrass.*

FIELD PARTY PHOTO 6-773-3

Photograph 26. - Semi-playa range site in low forage production class, lower Pumphernickel Valley. This site, wherever found, has no improvement potential beyond the low forage production class.

FIELD PARTY PHOTO 6-839-6



Table 1. -- Acreage of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Battle Mountain Sub-Basin

Vegetal type and site	Present annual forage plant		Potential annual forage plant		Treatment needed to reach	
	production classes (acres)		production classes (acres)		potential	
	850-1,500	200-900	20-300	850-1,500	200-900	20-300
1. Rabbitbrush-greasewood-grass; saline bottomlands						
Soil associations						
A5-A4-H2	-----	-----	15,900	3,000	10,000	2,900
A5-H2	5,000	1,600	4,400	8,600	2,400	-----
A5-H2-A4	800	13,300	1,500	10,800	4,800	-----
A5-S2	-----	-----	5,000	-----	3,000	2,000
A6-S2-H6	1,900	6,400	900	3,900	5,300	-----
A6-Y1-W1	-----	-----	1,000	-----	1,000	-----
A7-S5-A6	-----	200	12,200	-----	4,200	8,200
A13-A14-Y1-W1	-----	15,100	65,500	-----	35,100	45,500
A14-A13-Y1	-----	600	4,400	-----	2,600	2,400
H1-A6-A2	-----	-----	900	900	-----	-----
S2-A2	-----	-----	1,000	-----	1,000	-----
S2-A7-Y1	-----	2,100	25,000	-----	7,100	20,000
S4-A7-S2	-----	-----	2,300	-----	2,300	-----
S6-A13-Y1-W1	-----	-----	5,000	-----	2,000	3,000
S7-A3	-----	9,300	4,400	4,000	6,300	3,400
Subtotal	7,700	48,600	149,400	31,200	87,100	87,400
2. Semi-playa-greasewood-pickleweed; alkali bottomlands						
Soil associations						
A5-A4-H2	-----	-----	0-50	-----	-----	0-50
S6-A13-Y1-W1	-----	-----	500	-----	-----	500
A13-A14-Y1-W1	-----	-----	1,000	-----	-----	1,000
Subtotal	-----	-----	47,500	-----	20,000	27,500
			49,000		20,000	29,000

Continued

Table 1. -- Acreage of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Battle Mountain Sub-Basin -- Continued

Vegetal type and site	:	Present annual forage plant	:	Potential annual forage plant	:	Treatment needed to reach	
	:	production classes (acres)	:	production classes (acres)	:	potential	
<hr/>							
3. Meadow grasses-forbs-sedges; semi-wet meadow		Production classes		Production classes			
Soil associations		(pounds per acre) 1/		(pounds per acre) 1/			
		1,200-3,000	600-2,000	200-1,000	1,200-3,000	600-2,000	200-1,000
A5-A4-H2		6,800	-----	-----	6,800	-----	-----
A5-H2-A4		8,700	6,800	-----	15,500	-----	-----
A6-S2-H6		12,800	1,700	300	14,800	-----	-----
A13-A14-Y1-W1		4,800	-----	2,400	7,200	-----	-----
H1-A6-A2		7,500	1,800	-----	9,300	-----	-----
H1-A6-H4		6,600	10,800	-----	17,400	-----	-----
Subtotal		47,200	21,100	2,700	71,000	-----	-----
<hr/>							
4. Shadscale-grass; droughty desert uplands		Production classes		Production classes			
Soil associations		(pounds per acre) 1/		(pounds per acre) 1/			
		100-350	50-150	10-70	100-350	50-150	10-70
A13-A14-Y1-W1		-----	3,400	12,100	-----	8,400	7,100
D2-S7-A1		-----	-----	40,000	-----	30,000	10,000
R1-L1-B1		-----	6,100	-----	6,100	-----	-----
S2-A2		-----	-----	9,000	-----	5,000	4,000
S2-A7-Y1		-----	1,400	6,000	2,400	3,000	2,000
S2-D1		-----	-----	3,000	-----	1,500	1,500
S2-D2		-----	-----	21,000	-----	10,000	11,000
S2-D2-A2		-----	-----	14,700	-----	10,000	4,700
S6-A2		-----	-----	23,000	5,000	12,000	6,000
S7-A3		-----	3,700	16,300	3,700	5,000	11,300
S7-D1-G1		-----	-----	39,400	10,000	15,000	14,400
Subtotal		-----	14,600	184,500	27,200	99,900	72,000

Continued

Table 1. -- Acreage of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Battle Mountain Sub-Basin -- Continued

Vegetal type and site	Present annual forage plant		Potential annual forage plant		Treatment needed to reach	
	production classes (acres)		production classes (acres)		production classes (acres)	potential
5. Big sagebrush-grass; upland benches and terraces						
Soil associations						
	250-600	100-450	20-150	250-600	100-450	20-150
A5-H2	-----	-----	5,700	-----	2,000	3,700
A7-S5-A6	1,100	700	3,700	1,800	2,000	1,700
A14-A13-Y1-W1	-----	-----	2,600	-----	2,600	-----
B1-L1-B4-C4	-----	1,900	33,200	-----	18,900	16,200
B1-R5-L1	-----	-----	2,000	-----	2,000	-----
B3-S10-R6-L6	12,200	17,300	36,600	29,500	25,000	11,600
B3-S10-R6-Z	-----	-----	31,900	-----	15,000	16,900
B4-R1-L5	-----	-----	29,000	-----	19,000	10,000
B10-B11-B3-C2	-----	1,500	500	1,500	500	-----
D2-S7-A1	-----	-----	37,800	10,000	20,000	7,800
R1-B1-L1 (50-30-20)	-----	-----	12,400	5,000	7,400	-----
R1-B1-L1 (40-20-20)	-----	-----	5,000	-----	5,000	-----
R1-B1-L1-Z	-----	7,900	22,000	10,000	16,900	3,000
R1-B1-L12	-----	-----	16,000	-----	10,000	6,000
R1-L1-B1	-----	900	-----	900	-----	-----
R11-L12	-----	-----	14,000	7,000	7,000	-----
R12-L10-C1	-----	-----	1,800	800	1,000	-----
S2-A2	1,300	-----	30,500	20,000	11,800	-----
S2-A2-G3	-----	-----	7,000	-----	5,000	2,000
S2-A7-Y1	-----	2,000	12,700	2,000	5,000	7,700
S2-D2-A2	-----	-----	17,300	3,000	10,000	4,300
S3-B5	-----	-----	23,000	-----	15,000	8,000
S3-B10	-----	-----	11,000	-----	8,000	3,000
S3-G1	-----	600	74,000	-----	64,600	10,000
S4-A7-S2	-----	-----	16,700	-----	10,000	6,700
S4-G2-B4	-----	-----	51,700	10,000	30,000	11,700
S4-S7-A7	-----	-----	14,000	-----	10,000	4,000
S5-B1-L1	2,700	11,800	1,900	7,700	8,700	-----
S7-A12	10,700	300	9,000	18,000	2,000	-----
S7-A12-G1	-----	1,200	14,700	12,000	3,900	-----
S7-D1-G1	-----	-----	51,300	-----	35,000	16,300
S8-A2-G3	11,000	19,000	12,600	30,000	7,000	5,600
S9-B3-G3	3,800	2,900	47,200	26,700	20,000	7,200
Subtotal	42,800	68,000	648,800	195,900	400,300	163,400

Brush removal and seeding, selective spraying, fencing, stockwater development, streambank and channel stabilization, erosion-proofing of roads, intensify fire protection, proper management and stocking, provide and develop adequate water facilities for upland game birds. (An estimated 375,000 acres in this site may be suitable for seeding to improved grasses.)

Table 1. -- Acreage of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Battle Mountain Sub-Basin -- Continued

Vegetal type and site	Present annual forage plant		Potential annual forage plant		Treatment needed to reach potential	
	production classes (acres)		production classes (acres)			
	200-500	100-250	50-150	200-500	100-250	50-150
6. Low sagebrush-grass; claypan bench						
Soil associations	Production classes (pounds per acre)			Production classes (pounds per acre)		
B1-L1-B4-C4	800	8,700	-----	9,500	-----	-----
B1-R1-L1-Z	3,300	4,100	8,600	5,300	7,100	3,600
B3-S10-R6-L6	200	7,200	49,300	12,400	25,000	19,300
B3-S10-R6-Z	8,600	-----	17,000	8,600	10,000	7,000
R1-B1-L1	8,800	9,500	12,800	18,300	7,000	5,800
R1-B1-L1-Z	2,900	1,900	-----	4,800	-----	-----
R1-L1-B1	-----	2,400	-----	2,400	-----	-----
R12-L10-C1	4,300	2,600	1,900	6,900	1,900	-----
S3-B5	-----	-----	1,000	-----	1,000	-----
S3-B10	-----	-----	12,000	-----	6,000	6,000
S5-B1-L1	4,700	6,400	500	11,100	500	-----
S8-A2-G3	1,000	400	-----	1,400	-----	-----
S9-B3-G3	-----	-----	11,900	3,000	5,000	3,900
Subtotal	34,600	43,200	115,000	83,700	63,500	45,600
7. Browse-aspen-grass; inter-mediate mountain slopes						
Soil associations	Production classes (pounds per acre)			Production classes (pounds per acre)		
	300-650	150-350	50-200	300-650	150-350	50-200
B1-L1-B4-C4	-----	5,700	5,500	5,700	3,500	2,000
B1-R1-L1-Z	24,600	6,700	47,800	31,300	20,000	27,800
B3-S10-R6-L6	2,900	1,500	2,500	4,400	1,500	1,000
B3-S10-R6-Z	5,800	900	30,800	16,700	15,000	5,800
R1-B1-L1	2,800	3,100	1,400	7,300	-----	-----
R1-B1-L1-Z	12,400	-----	1,700	12,400	1,700	-----
R1-L1-B1	-----	-----	14,600	-----	10,000	4,600
R12-B1-C1-L12	-----	6,800	11,700	6,800	6,000	5,700
R12-L10-C1	800	9,900	5,700	10,700	5,700	-----
Subtotal	49,300	34,600	121,700	95,300	63,400	46,900

Continued

Table 1. -- Acreage of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Battle Mountain Sub-Basin -- Continued

Vegetal type and site	Present annual forage plant		Potential annual forage plant		Treatment needed to reach	
	production classes (acres)		production classes (acres)		potential	
8. Pinyon-juniper-grass; shallow stony slopes Soil associations	Production classes (pounds per acre) 1/		Production classes (pounds per acre) 1/		Removal of pinyon-juniper in small blocks on invaded livestock or big game range, fencing, stockwater development, streambank and channel stabilization, erosion-proofing of roads, intensify fire protection, proper management and stocking.	
	100-250	50-150	10-75	10-75		
	-----	-----	2,500	-----		
	-----	-----	2,500	2,500		
	-----	-----	-----	2,500		
R12-B1-C1-L12						
Subtotal						
9. Browse-aspen-conifer- grass; steep mountain slopes and basins Soil associations	Production classes (pounds per acre) 1/		Production classes (pounds per acre) 1/		Fencing, streambank and channel stabil- ization, erosion-proofing of roads, con- tour trenching, gully plugs, intensify fire protection, proper management and stocking.	
	350-800	200-500	75-250	350-800		
	300	15,200	3,400	7,300		
	4,400	100	700	5,200		
	-----	9,600	3,400	9,600		
B1-R1-L1-Z						
R1-B1-L1						
R1-L1-B1						
Subtotal						
Total						

1/ These figures indicate total annual forage production (dry weight), and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency.

These rates represent production variance from poor years to good years. At higher elevations within the site, with greater precipitation the rates would be higher, and conversely for lower elevations.

2/ Does not include 2,600 acres of barren.

Source: Humboldt River Basin Field Party.

The rates in table 1 are indicative of the total annual forage production, and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and management objectives of private owners or Federal administrative agencies.

Approximately 30 percent of the medium and fairly high forage production range is located in the fenced bottomlands of ranches along the Humboldt River. Within this area, approximately 145,000 acres approach the high forage production class. Most of this land is flooded during periods of high runoff. This acreage is entirely fenced, and is used for grazing only during the winter and early spring months. The remainder of the range in the medium and fairly high forage production classes is found in the less accessible mountainous portions of the sub-basin, and in the scattered seedings of crested wheatgrass.

The widely known 15,000-acre fenced St. John Fields are located on the western slopes of the Tuscarora Range, in the northeast corner of the sub-basin. Here a portion of the range approaches production conditions and vegetal types similar to those found on the upper Snake River Plains and the Palouse rangelands in Idaho and Washington, with Idaho fescue, bluebunch wheatgrass, Nevada bluegrass, and Great Basin wildrye being the dominant species. Density of cover in this area approaches the optimum; there is little evidence of accelerated sheet or gully erosion. (See photograph 27.)

Photograph 27. - Big sagebrush-grass range in fairly high forage production class, steep mountain slopes and basins site. St. John Fields, Jenkins 25 Ranch, Tuscarora Range. The principal perennial grasses present are Nevada bluegrass, Idaho fescue, Hesperochloa (Hesperochloa kingii), and bluebunch wheatgrass. Stocking rates for cattle here have been estimated to range from three and one-half to six and one-half acres per A.U.M. Looking northwest toward the Willow Creek Reservoir.

FIELD PARTY PHOTO 6-785-4





Photograph 28. - Eroded and silted stream channel, lower Rock Creek, two miles north of the Antelope Creek Road.

FIELD PARTY PHOTO 6-791-5

A sharp contrast in watershed conditions is found a few miles downstream from the St. John Fields. Starting at the fence lines of these fields, watershed conditions progressively worsen throughout the length of Little Antelope and Soldier Creeks and their tributary drainages. Along these drainages, the better forage species are depleted, and the stream bottoms are deeply channeled. Rock, Antelope, and Willow Creeks are also channeled or gullied throughout their length. These gullies vary from three to 15 feet in depth, and from 20 to 50 feet in width. (See photograph 28.)

A considerable amount of accelerated sheet erosion occurs in the Macks-Welch Creek area on the east side of Boulder Flat. Approximately 20,000 acres were burned here by a lightning-caused fire in 1957. Since then several heavy convection summer storms have passed over these watersheds, dumping a large amount of water in a few hours, and causing severe gully and sheet erosion on the nearly denuded slopes.

Most of the area seeded to crested or Siberian wheatgrass in the sub-basin is in the fairly high forage production class. Exceptions are 2,600 acres on the east side of the Antelope seeding, which is in the medium forage production class, and the 1,200-acre Macks Creek seeding, which is in the low forage production class.

Nearly all the shadscale-bud sage site acreage is in the low forage production class, except for a small area on Golconda Summit (See table 1.)

Phreatophytes

The phreatophytes of the sub-basin consist mainly of black greasewood, rubber rabbitbrush, alkali seepweed, rose, willow, and saltgrass. Except for willow, they occur as relatively pure stands of each species, or as admixtures of several. Willow and greasewood, while growing in close proximity, are very seldom found together.

The phreatophytes occur in three vegetal sites: (1) saline bottomland; (2) semi-wet meadow; and (3) semi-playa. These range sites make up approximately 20 percent of the total sub-basin range area, or 328,000 acres (see photographs 9 and 15). However, the acreage occupied by phreatophyte plants alone on these three sites is estimated to be 213,000. (See table 2.)

Density of the greasewood and rabbitbrush stands varies from practically zero to 15 percent. Density of the willow stands, particularly on the river and stream banks, runs as high as 60 percent.

Willow and rose are mainly confined to land areas near stream courses. In this location, they, as well as more beneficial vegetation found there, prevent undercutting and mining of the stream banks. Other than this, and except as shade, shelter and wild-life feed, willow and rose have little economic value. Total use of water by these plants is estimated to be 4,500 acre-feet annually.

There are extensive areas of black greasewood in the Kelly Creek and Izzenhood bottomlands, north and east of Valmy. This area is nearly continuous, extending from the Getchell Mine road southeast 30 miles along the north side of the Humboldt River to the Blossom Ranch. There is little grass or forb understory in these greasewood stands. Plants present in the understory, but very dispersed, are saltgrass, alkali sacaton, Great Basin wildrye, pickleweed (*Allenrolfea occidentalis*), and bassia (*Bassia* spp.). Ground cover density in these greasewood stands is very low - usually less than five percent.

Within this broad greasewood type there is a large acreage in the transition belt between shadscale and greasewood. Here greasewood, with such other shrubs as cotton-thorn horsebrush, littleleaf horsebrush, shadscale, bud sage and big sagebrush, occur in practically equal percentages. Spiny hopsage and Nuttall's saltbush (*Atriplex nuttallii*) are also present, but usually in lesser amounts. Greasewood is dominant in the phreatophyte type on Boulder Flat, and in the fringe area around the Horseshoe Ranch at Beowawe.

Rubber rabbitbrush is dominant in only a few phreatophyte stands throughout the sub-basin. The largest area of rubber rabbitbrush is along the north side of the Humboldt River, extending approximately 10 miles northwest from the Blossom Ranch. Other stands of rabbitbrush are found between the Jenkins 25 and the White House Ranches, and on the T S Ranch between the Humboldt River and the entrance gate.

Away from the Humboldt River, rabbitbrush occurs as stringers of varying widths along creeks and drainage courses, or as small islands in other range types. Plants

Table 2. -- Phreatophyte acreage and annual ground water use, Battle Mountain Sub-Basin 1/

Species	Height class	Density	Acreage : cropland	Acreage : range types	Annual ground water use <u>2/</u> : (acre-feet)
Willow	4-12'	.4-.6	-----	1,800	2.2
Rose	3-6'	.4-.6	-----	400	1.5
Black greasewood	3'+	.02-.15	-----	30,300	.3
Black greasewood	3'-	.02-.08	-----	87,500	.2
Rubber rabbitbrush	3'+	.02-.15	-----	17,800	.3
Alkali seepweed	2'-	.02-.08	-----	10,000	.5
Saltgrass	----	.02-.15	-----	22,400	.5
Great Basin wildrye	----	.02-.6	-----	29,000	1.0
Creeping wildrye	----	.02-.6	-----	5,000	1.0
Alkali sacaton	----	.02-.15	-----	8,800	.5
Subtotal				<u>213,000</u>	<u>91,000</u>
Irrigated meadow hay and pasture <u>3/</u>	----	-----	4,800		.3
Alfalfa	----	-----	600		.5
Wet meadow <u>3/</u>	----	-----	400		.5
Subtotal			<u>5,800</u>		<u>1,900</u>
Total			5,800	213,000	92,900

1/ These values in the table, when referred to in the text, are rounded.

2/ These values are based on natural stand densities and 100 percent composition, for each species, except for the irrigated and wet meadows.

3/ Mixture of Great Basin wildrye, creeping wildrye, sedges, and other grasses.

Source: Humboldt River Basin Field Party.

associated with these rabbitbrush stands are greasewood, big sagebrush, Great Basin wild-rye, bassia, thelypody, and lambsquarters (*Chenopodium album*).

The greasewood and rabbitbrush stands are of low economic value. It is estimated they are using 31,900 acre-feet of water annually.

A large acreage of native grass pasture occupies the semi-wet meadow and the saline bottomland vegetal sites. Dominant plants in these pastures are Great Basin wild-rye, saltgrass, alkali sacaton, and creeping wildrye. These plants are phreatophytic, but their use is considered beneficial except for saltgrass. (See photograph 14.)

Total use of water by beneficial phreatophytes in the sub-basin is estimated to be 38,400 acre-feet. Nonbeneficial phreatophytes, including saltgrass, consume 52,600 acre-feet. (See table 2.)

Timber Management

There are no commercial sawtimber stands within the sub-basin. The Bureau of Land Management has no program of commercial timber cutting on the national land reserve (public domain), as there are no stands of pinyon, mountain mahogany, or commercially valuable juniper present. The thin, widely scattered stands of aspen are most valuable as protection types, or for their aesthetic value and shade (see photographs 10 and 29). Rigorous beaver control is needed, not only from an erosion control standpoint, but to protect the recreation and aesthetic values of the hard-to-replace aspen stands in the upper reaches of Rock Creek and its tributaries.

Photograph 29. - One of the many fine aspen stands in the canyons and basins at the head of Rock Creek. Stands such as this are most valuable as watershed protection types, or for their aesthetic value and shade. If properly developed, so as to avoid too great human congestion and trampling, these extensive aspen groves offer many excellent opportunities for campground and recreation area development.

FIELD PARTY PHOTO 6-791-12



Fire Protection

Range fires in the immediate past have caused widespread watershed damage in the sub-basin, and remain an omnipresent threat. With deterioration or destruction of the original plant cover, whether brought about by fire or other watershed abuse, the invading vegetal types increase the fire hazard by providing flash fuels. Fires on the steep, brush-covered, thin-soiled slopes of the Tuscarora Range, the Sheep Mountains, the Galena Range, and the Snowstorm Mountains could be seriously damaging to these important water-yielding areas.

Risks of fires caused by the rapidly increasing recreation and hunter use of the watershed lands will continue to mount. The significance of these water-yielding lands to the arid valleys below makes fire protection a factor of increasing importance. Prevention or prompt suppression of potentially disastrous range fires is now and will continue to be an important facet of resource and watershed management.

RECREATION AND WILDLIFE

Recreation Developments

Although little or nothing has as yet been done toward a planned development of the Battle Mountain Sub-Basin's recreation potential, it possesses many opportunities. As the population buildup continues, and with improved access, and with fuller recognition and development of this largely untapped resource, the sub-basin's recreation potential could become one of its outstanding assets. This is particularly true of the beautiful aspen basins and the high, open ridges in the Tuscarora Range at the head of Rock Creek (see photograph 29). The area in the vicinity of Willow Creek Reservoir, the Snowstorm Mountains, and the Sheep Mountains also have many undeveloped sites which possess a good recreation potential.

In addition to camping, picnicking, hunting and fishing, there are great possibilities for such hobby-type phases of recreation as rock collecting and Indian artifact hunting.

Within its boundaries, on both national land reserve and privately owned lands, there are many points of historical significance. These are being increasingly sought out by tourists, historians, and hobbyists in general, from within and outside the State of Nevada. The celebration of Nevada's Centennial (1964) has stimulated a greatly increased interest in the many stirring events of the State's history. Much of this heightened interest will undoubtedly continue in the future, and a great deal of it will of necessity be concentrated in this sub-basin, where many momentous events occurred.

Some sites gained fame during the covered wagon period of westward migration. A few of the most important are Emigrant Pass, Gravelly Ford, the Maiden's Grave, the Humboldt meadows through the Battle Mountain Basin, and the Comus narrows - actual site of Reed's murder of Snyder in the Donner Party trek (see photographs 1, 5, 30, and 31). One location in the Galena Range, also associated with this period, was the scene



Photograph 30. - Pioneer graves at historic Gravelly Ford, where the California Emigrant Trail forded the Humboldt River, about five miles east of Beowawe, looking southwest toward the Shoshone Mountains. The small cross marks what was long mistakenly presumed to be the 1846 grave of John Snyder, murdered by James Reed, both of the ill-fated Reed-Donner Party. Once, a well-kept picket fence surrounded the approximately 30 graves of pioneers who died at this grim crossing. Now, the site has been abandoned to the ravages of weather and livestock trampling. Its premier position in the annals of western history, and its present dilapidated condition, make its immediate repair and permanent upkeep a matter of State and national concern.

FIELD PARTY PHOTO 6-778-9

Photograph 31. - The grave of Lucinda Duncan, member of an emigrant party of the early 1860's who died and was buried at the old emigrant camp site along the Humboldt near the railroad tracks at the right side of the photograph. With the advent of the Central Pacific Railroad late in 1868, her remains were moved to their present resting place. In refreshing contrast to the graves at Gravelly Ford, this site, commonly known as the Maiden's Grave, has been carefully kept up through the years by the Southern Pacific Railroad. (Looking northwest down the Humboldt Valley; the hamlet of Beowawe is in the left background.)

FIELD PARTY PHOTO 6-788-7



of the little-known battle between whites and renegade Shoshones in 1850 from which the Battle Mountain (Galena) Range, mining district, and town derived their names.

Other locations became significant during the mining period, such as the freight and stage roads from Battle Mountain and Winnemucca to Tuscarora and Cornucopia. Midas, the ghost mining town on a Rock Creek tributary, is also of historical interest.

National Land Reserve (Public Domain)

At present, there are no camp and picnic areas or any other recreation developments on these lands. The Elko District, in its 1961 recreation inventory report, proposes the construction of several camp and picnic areas, cabin sites, and historical sites. (See table 3.)

Wildlife

Deer and Other Big Game Hunting

The Battle Mountain Sub-Basin, although not as high-yielding an area from the standpoint of numbers, at least, as the Mary's River or North Fork Sub-Basins, does produce a good deer harvest each year. This is particularly true of its fringe areas in the higher Tuscaroras.

Mule deer range over all the higher mountainous areas of the sub-basin during the summer months. Greatest summer-range concentrations and deer hunting pressures occur on the slopes of Mt. Blitzen, at the headwaters of Rock, Toe Jam, Lewis, Nelson, and Willow Creeks, with the annual kill approaching 500 head. A moderate deer population uses the upper portions of Antelope Creek. In the Snowstorm Mountains, large summer populations are found at the head of Kelly Creek, and on Frazier Creek. To date, hunting pressure here has been light.

Greatest winter concentrations occur from Nelson Creek southwestward, including the Ivanhoe Mine, Black Mountain, the Izzenhood Ranch area, and the rocky heights of the Sheep Mountains. The deer migrate to these winter ranges from the upper Tuscarora and Snowstorm summer ranges. Some deer from the Snowstorms also migrate to the east slope of the Osgoods, including the Kelly Creek and Evans Creek drainages. It is believed that a considerable number of deer migrate from the southern Tuscaroras southward across Emigrant Pass and Palisade Canyon into the northern Cortez Range during the winter months, based upon general observations by State Fish and Game Commission technicians and others. More study, in the form of tagging, road dragging and track counts, etc., are needed to confirm this hypothesis.

Deer are present throughout the year along the Humboldt River, from Beowawe to Comus. Heavy stands of willow furnish excellent cover, and at the same time make hunting difficult. Damage to haystacks along the river occurs almost every winter to some extent, especially to alfalfa hay in stackyards not adequately fenced.

Table 3. -- Potential developments, recreation inventory report, 1961 and subsequent supplements, national land reserve, Battle Mountain Sub-Basin

Site name and type of development	: Acres:	: Site : devel.:	Access roads				: Trails : Devel.:	: Water : devel.:	: Total : devel.:	:Area affected : acres		
			:Miles:	: cost :	:Right of way :acquisition :	:Yearly : maint. :						
	(dols.)	(dols.)	(dols.)	(dols.)	(dols.)	(dols.)	(dols.)	(dols.)	(dols.)	(dols.)		
Coyote Basin cabin site upper Boulder Creek	1	4,600	25	1,500	-----	375	--	-----	Inc. in site dev. cost	6,500	160	--
Midas Historical camp site	2	1,000	--	-----	-----	---	--	-----	500	1,500	40	--
Willow Creek Reservoir camp site	2	1,000	1	250	-----	---	--	-----	600	1,600	80	--
Ivanhoe camp and rock hunting site	1	500	5	1,250	-----	---	20	1,000	400	3,100	10,240	--
Izzenhood camp and cabin site	1	4,600	11	2,750	1,200	---	--	-----	Inc. in site dev. cost	8,500	320	--

Source: Bureau of Land Management, Elko District.

So far as is known, range and watershed damage in this sub-basin accruing from deer concentrations and use is minor.

Fisheries

In the Tuscaroras, upper Rock Creek, Toe Jam Creek, Nelson and Lewis Creeks, and Frazier Creek in the Snowstorms contain populations of native cutthroat trout. Most of these streams are fished only lightly, and therefore would not warrant stocking, even if these trout were available for planting.

Lower Rock Creek is a warm water fishery for two or three miles above its confluence with the Humboldt River. Populations of largemouth bass, white crappie, and sunfish are present, and furnish a satisfactory local fishery. Giant bullfrogs are especially abundant in this area, and are much sought after by frogleg enthusiasts. These lower Rock Creek fisheries are all self-sustaining.

Kelly and Evans Creeks are fishable waters; they were stocked periodically from 1953 to 1957 with reared rainbow and eastern brook trout.

Willow Creek Reservoir, fed by Lewis and Nelson Creeks, was first constructed in 1884 by the Nevada Land and Cattle Company, Ltd. (see Settlement, this report). Under subsequent ownerships, including the Palo Alto Land and Livestock Company (the Spanish Ranch) and the Ellison Ranching Company, the dam has been enlarged and strengthened at various times, to augment reservoir storage. (See photograph 32.)

Photograph 32. - Willow Creek Reservoir, eight miles above Squaw Valley Ranch, looking west. First constructed in 1884 by the English-owned Nevada Land and Cattle Company, Ltd., for irrigation on its Squaw Valley Ranch, it was for many years a prime trout fishery. However, repeated depletions of the reservoir water in the 1950's, coupled with the roily waters resulting from wave action on the mud of its silty bottom, have greatly reduced its present value for fishing.

FIELD PARTY PHOTO 6-784-11



Water storage conditions prior to 1954 are not known, but since that date the reservoir was totally depleted during the irrigation seasons of 1954, 1959, and 1960. According to qualified observers, the reservoir furnished very good fishing prior to these periods of complete drainage, and the harmful effects of roily water resulting from wave action on the heavily silted reservoir bottom. Many Elko and Tuscarora fishermen caught cutthroat trout from 15 to 20 inches long when these fish ran upstream in the spring from the reservoir into Nelson and Lewis Creeks. In 1959, an attempt to trap and take eggs from these stream-running cutthroats met with moderate success. However, the periodic depletion of the reservoir discouraged further repetition of this endeavor.

Prior to 1957, so far as is known, no fish stocking of the reservoir was ever carried out. In 1957, 300 pounds of legal-size cutthroat were planted, followed by 26 pounds in 1958. In 1963, 1,000 pounds of eastern brook trout were introduced as an experiment, although no great expectations are entertained as to the successful outcome of the planting. As long as reservoir water levels remain high, however, further fish introductions are planned by the Nevada Fish and Game Commission.

Small Game

This sub-basin is quite well known for its small game hunting. The chukar partridge is abundant, along with valley quail, mountain quail, and sage grouse. A small number of pheasants inhabit the bottomlands along the Humboldt, from Dunphy westward. Waterfowl are abundant along the Humboldt River, and are found in lesser numbers along Rock Creek and on Willow Creek Reservoir. Cottontails are locally common, along the Humboldt and larger stream bottoms.

PROGRAMS OTHER THAN PROJECT-TYPE DEVELOPMENTS AVAILABLE FOR THE IMPROVEMENT OF WATER AND RELATED LAND RESOURCES

Lands in the sub-basin can be treated or can receive aid for treatment under existing U.S. Department of Agriculture and other Federal and State programs. The Bureau of Land Management is responsible for range, recreation, and watershed developments on the Federal land it administers. The owners of private land can receive aid for water and related land resources development by means of various programs under the U.S. Department of Agriculture.

Technical Assistance and Cost-Sharing Under Public Law 46

Under the provisions of Public Law 46 the Soil Conservation Service furnishes technical assistance through Soil Conservation Districts, and the Agricultural Conservation Program of the Agricultural Stabilization Conservation Service provides cost-sharing. Under these programs, assistance in developing coordinated conservation plans and in applying conservation measures may be furnished for farms and ranches. These plans provide for surveys, land use adjustments, erosion control, water conservation, irrigation, drainage, flood prevention, and recreation development. Solution to the sub-basin problems on private land may be arrived at in part by these programs.

The Soil Conservation Service has the responsibility for leadership in the National Cooperative Soil Survey. With the assistance of several cooperative groups and agencies in this work, soils maps and survey reports will be published in the regular schedule of soil survey publications of the U. S. Department of Agriculture.

Agricultural Water Management

There are many ways of improving water management on individual ranches throughout the sub-basin. Some of the treatments for various types of problems are listed below.

<u>Problems</u>	<u>Suggested treatment</u>
1. Limited water supply.	<ul style="list-style-type: none">a. Develop irrigation water by drainage of seeps, springs and high water table.b. Control of phreatophytic plant growth.c. Construct overnight storage reservoirs to better utilize small flows for irrigation.d. Clear stream channels of all obstructions and install diversions with adequate control features.e. Development of irrigation water wells where investigation reveals their feasibility.f. Line or seal ditches through reaches of excessive seepage loss (see photograph 33)g. Stop applying water to fields after soil reaches field capacity.
2. Saline soils.	<ul style="list-style-type: none">a. Install drains, to lower water table.b. Use only good quality water for irrigation, to reduce salt concentration in the soil.c. Use proper soil and water management practices.
3. High water table.	<ul style="list-style-type: none">a. Install suitable drainage.b. Improve creek channels for drainage outlets, and to reduce frequent flooding of bottomland.c. Check the possibility for pump drainage. This may increase water supply for irrigation.d. Land smoothing to remove low ponding areas.



Photograph 33. - Constructing a concrete ditch, Dunphy Ranch. Ditches carry the water from one well and a sump to the alfalfa fields.

S.C.S. PHOTO 6-408-9

- e. Line and seal ditches.
 - f. Stop applying water to fields after soil reaches field capacity.
4. Low-efficiency use of water.
- a. Level or smooth land for even water application.
 - b. Reorganize water distribution and irrigation systems.
 - c. Line ditches through highly permeable soils.
 - d. Stop applying water after soil reaches field capacity.
 - e. Plant high-yielding crops suitable for conditions, to reduce irrigated acreage now needed for hay production.
5. Inadequate water distribution systems.
- a. Install diversions with adequate control features (see photograph 34).
 - b. Reorganize water distribution systems.
 - c. Use lined ditches or pipe lines through highly permeable soils.
 - d. Construct necessary control structures in ditches (see photograph 35).



Photograph 34. - Typical rock and brush dam, Humboldt River, on W. E. Licking Ranch, near Battle Mountain, Nevada. This type of diversion makes control of water difficult.

S.C.S. PHOTO 6-762-12

Photograph 35. - Two-way irrigation structure, main T S Ranch, Humboldt River bottomlands. Irrigation water from either the wells or the river flows through this irrigation system to irrigate the alfalfa fields.

S.C.S. PHOTO 6-600-5



Vegetal Improvement

Stream bank cutting and channel erosion, as well as watershed erosion on privately owned land, indicate the need for action to reverse the trend toward meadow desiccation and land deterioration. Each of the following solutions would contribute in some measure to the improvement of plant species and cover, which in turn will help reduce this erosion.

Problems

Suggested treatment

Irrigated lands

- | | |
|---------------|---|
| 1. Low yields | <ul style="list-style-type: none">a. Establish higher-yielding forage crops suitable to the soil and water conditions, for hay and pasture.b. Use irrigation methods that will permit more efficient use of water and create an environment for higher producing forage plants.c. Use proper soil and water management practices and adapted vegetal species, particularly on saline-alkali soils.d. Thorough investigation of response in plant yields to commercial fertilizers.e. Do not feed on wet fields. |
|---------------|---|

Nonirrigated lands

- | | |
|--|--|
| 1. Range condition static or on decline. | <ul style="list-style-type: none">a. Practice rotation-deferred grazing.b. Use bottomland pasture to supplement available range.c. Control low economic value plant growth to increase forage production.d. Control noxious and poisonous plant growth, for range betterment.e. Develop a program of seeding and rehabilitation of suitable rangelands, or as replacement areas for seriously depleted critical watersheds unsuitable for grazing.f. Establish proper use practices.g. Fence, to enable better grazing control and proper range use.h. Improve salting and water distribution for better grazing control. |
|--|--|

Watershed Protection and Erosion Control

Except for the inaccessible and fenced areas, which are relatively small compared to the total acreage, the broad flat terraces and adjacent uplands are generally in poor condition. The treatment required to reverse the condition trend in this area would include range seeding (estimated 400,000 acres) and spraying of sagebrush on selected sites, along with good range management and proper use.

Channel and gully erosion are very active throughout the sub-basin. Permanent type control structures and land treatment measures are needed to protect the existing meadows and restore desiccated meadowlands. In addition, such practices as bank sloping, seeding of banks, and channel fencing along selected areas will help heal the erosion.

Possibilities for Water Salvage

Ground water use by phreatophytic plants was estimated to be about 91,000 acre-feet annually. This includes the water used by Great Basin wildrye and other wet meadow species harvested for hay and pasture in the valley bottoms.

Phreatophytic plants of low economic value, such as willow, greasewood, rabbitbrush, wild rose, seepweed, and saltgrass use an estimated 52,600 acre-feet of water annually. More effort should be made to control or replace these water-consuming plants by chemical control, deep drainage, and blading. A large portion of this water could be salvaged or put to better use by the control or replacement of most of these water-consuming plants.

Bureau of Land Management Programs

National Land Reserve (Public Domain)

The Bureau of Land Management is responsible for the administration and management of approximately 51 percent of the acreage in the Battle Mountain Sub-Basin. Highlights of the Bureau's range management program include the proper use and improvement of the national land reserve. In addition, the Bureau is responsible for fire suppression and control activities on the intermingled public and private lands it administers.

Adjudication of grazing privileges in this sub-basin has only begun. After the adjudications are completed and the allotments are fenced, management plans will be developed for each allotment to insure proper use of the forage resources.

The soil and moisture program is integrated with the grazing program, and consists of stabilization and rehabilitation projects necessary to conserve soil, water, and closely related resources. The work also includes improvement of vegetation through natural revegetation, control of undesirable forage plants, seeding of more desirable plants, as well as soil surveys and hydrological studies on pilot watershed areas. The weed control program is designed to arrest the invasion and spreading of weed species which are poisonous

or mechanically injurious to domestic livestock, or which threaten the agricultural economy of the area. Another facet of range and watershed management requiring immediate attention is the erosion-proofing or revegetation and retirement of old, abandoned, or low-standard roads, the contributory source of a considerable amount of washing, gullying and sedimentation. It is planned that the construction of all new roads will be done to proper standards and with adequate drainage.

Land classification, fire protection, and recreation are important phases of the Bureau of Land Management program. The long range land program includes the encouragement of land exchanges, in order to establish a more desirable land pattern, particularly on the higher watershed lands. The Bureau's proposed recreation development program is briefly outlined in table 3.

The national land reserve in the Battle Mountain Sub-Basin, along with intermingled private lands, provides summer and winter range for deer. Deer from the Independence, Tuscarora, and Snowstorm Mountains migrate into parts of this area during the winter months, while others cross the sub-basin enroute to their winter range in adjacent southern valleys.

Fire Protection

One Federal agency and one State agency are charged with the responsibility for fire prevention and suppression within the sub-basin. The Elko, Battle Mountain and Winnemucca Districts of the Bureau of Land Management share the fire protection job on the national land reserve. The State of Nevada, through its Clarke-McNary Northeastern Nevada Fire Protection District, protects the private lands in Elko County, and assists the Bureau of Land Management with its fire suppression job in this county.

The following factors have helped or are needed to keep abreast of the increasing fire risks and hazards:

1. The introduction of new techniques, including more widespread and aggressive fire protection, and improved fire prevention and patrol measures.
2. More and better suppression equipment. The agencies concerned have established an air tanker base at Elko, to be used on the suppression of wild fires.
3. The recognition of high hazard areas from the study of past fire occurrence maps and fuel type maps, as well as keeping posted on new cheatgrass area buildups. Where possible, convert from high hazard species to lower fire danger cover.
4. Intensified and more diligent inspection and hazard elimination along the Southern Pacific and Western Pacific rights-of-way. Insist that railroads adhere closely to the Nevada fire laws with

respect to fireproofing of diesel locomotives. Trucking firms and contractors using internal-combustion equipment should also be checked for compliance with this section of the fire laws.

5. Use improved national fire danger rating systems.
6. Improved fire detection and radio communications.
7. Continue with and intensify cooperation between Federal and State agencies for fire prevention, detection and suppression.
8. Inclusion of cooperator ranch crews in Federal and State control organizations.
9. Hazard reduction in connection with road maintenance and recreation site development.
10. Organization of Clarke-McNary fire protection districts for private lands of those portions of the sub-basin outside the existing Northeastern Nevada Fire Protection District (Elko County).

WATERSHEDS WITH OPPORTUNITIES FOR PROJECT-TYPE DEVELOPMENT

The Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, as amended) authorizes the Secretary of Agriculture to give technical and financial help to local organizations in planning and carrying out works of improvement in watershed or subwatershed areas of 250,000 acres or less. These projects are for: (1) flood prevention; (2) agricultural phases of water management; (3) public recreational developments; and (4) other purposes, such as municipal and industrial water supplies, and improvement for fish and wildlife.

Project works of improvement include land treatment measures and individual structures having not more than 5,000 acre-feet of flood-water detention capacity, or not more than 25,000 acre-feet of capacity for all purposes.

Watershed projects provide a means for accelerating coordinated scheduling and installation of needed improvement on public and private lands.

This study of the Battle Mountain Sub-Basin did not reveal land and water use problems which might be solved under the present interpretations of the Watershed Protection and Flood Prevention Act.

Investigations have been made for a project on lower Rock Creek by various State and Federal agencies, starting prior to 1919 and continuing through recent times. A reservoir dam at this site could provide for flood protection, irrigation storage, and recreation use. The Field Party studied this site for a possible project under Public Law 566, but it was determined that the land area involved was greater than the 250,000-acre

limitation. Possibly this project could be consummated under other Federal or State programs. (See photograph 36.)

Another watershed project investigated by the Field Party concerned the drainages of upper Rock Creek, with a possible reservoir dam to be located at the confluence of Toe Jam Creek and Rock Creek. The purpose of the project would be flood prevention, irrigation storage, recreation use, and watershed rehabilitation. The present single land ownership in the benefit area below the proposed structure, however, precludes the development of this project under the present interpretation of Public Law 566.

Photograph 36. - Site of proposed dam for reservoir on lower Rock Creek, three miles above canyon mouth where Rock Creek discharges on Boulder Flat.

FIELD PARTY PHOTO 6-791-4



REFERENCES

Books, Handbooks

Economics

U. S. Dept. of Commerce, Bureau of the Census. Census of agriculture, 1929-1959.

History

Abdill, George. 1959. Pacific Slope Railroads, 1854-1900. Superior Publishing Co., Seattle. 182 p.

Ashbough, Don. 1963. Nevada's turbulent yesterday. Westernlore Press, Los Angeles.

Camp, Charles L. 1960. James Clyman, frontiersman. The Champoege Press, Inc., Portland, Oregon. 353 p.

Chittenden, H. M. 1954. The American fur trade of the far west. Academic Reprints, Stanford, Cal. 2 Vols. 1029 p.

Cline, Gloria Griffen. 1963. Exploring the Great Basin. Univ. of Okla. Press, Norman. 254 p.

DeVoto, B. 1942. 1846, year of decision. Houghton-Mifflin, Boston. 538 p.
1948. Across the wide Missouri. Houghton-Mifflin, Boston. 483 p.

Egan, William M. 1917. Pioneering the west, 1846 to 1848. Major Howard Egan's diary. Howard R. Egan Estate, Richmond, Utah. 194-225.

Ewers, John C. 1959. Adventures of Zenas Leonard, fur trader. Univ. of Okla. Press, Norman. 172 p.

Fletcher, F. N. 1929. Early Nevada. The period of exploration, 1776-1848. A. Carlisle & Co. of Nev., Reno. 183 p.

Galloway, John D. 1950. The first transcontinental railroad: Central Pacific-Union Pacific. Simmons-Boardman, New York. 319 p.

Goodwin, C. L. 1930. John Charles Fremont, an explanation of his career. Stanford Univ. Press, Cal. 285 p.

Griswold, Wesley S. 1962. A work of giants. McGraw-Hill, New York. 367 p.

Gudde, Erwin G. 1962. Bigler's chronicle of the west. Univ. of Cal. Press, Berkeley. 145 p.

- Hine, Robert V. 1962. Edward Kern and American expansion. Yale University Press. 180 p.
- Howard, Robert W. 1962. The great iron trail. G. P. Putnam's Sons, New York. 376 p.
- Korns, J. Roderick. 1951. West from Fort Bridger. Utah State Hist. Soc., Salt Lake City, Utah. XIX. 297 p.
- Leinhard, Heinrich. 1961. From St. Louis to Sutter's Fort, 1846. Univ. of Okla. Press, Norman. 204 p.
- Lincoln, Francis Church. 1923. Mining districts and mineral resources of Nevada. Nev. Newsletter Pub. Co., Reno. 295 p.
- Mills, Lester W. 1956. A sagebrush saga. Art City Publishing Co., Springville, Utah. 112 p.
- Moody, Ralph. 1963. The old trails west. Crowell Publishers, New York.
- Morgan, Dale L. 1943. The Humboldt, highroad of the west. Farrar Publishing Co., N. Y. 374 p.
1959. The overland diary of James A. Pritchard. The Old West Publishing Co. 221 p.
1963. Overland in 1846. Diaries and letters of the California-Oregon Trail. Talisman Press, Georgetown, Cal. 2 Vols. 875 p.
- Murbarger, Nell. 1956. Ghosts of the glory trail. Desert Magazine Press. 291 p.
- Myles, Myrtle. 1951, 1956. Pioneer Nevada. Harold's Club, Reno. 2 Vols. 364 p.
- Myrick, David. 1962. The railroads of Nevada and eastern California. Howell-North Press, Oakland. Vol. 1. 343 p.
- Nevins, Allan. 1939. Fremont, pathmaker of the west. D. Appleton-Century Co., N. Y. 649 p.
- Paden, Irene. 1944. Wake of the prairie schooner. The Macmillan Co., New York. 514 p.
1948. The journal of Madison Berryman Moorman, 1850-1851. Calif. Hist. Soc., San Francisco. 145 p.
1949. Prairie schooner detours. The Macmillan Co., New York. 295 p.
- Phillips, Paul C. 1961. The fur trade. Univ. of Okla. Press, Norman. Vol. 2. 696 p.
- Pigney, Joseph. 1961. For fear we shall perish. E. P. Dutton & Co., New York. 312 p.

- Rich, E. E. 1961. Hudson's Bay Company, 1670-1890. The Macmillan Co., New York. Vol. 3. 573 p.
- Rogers, Fred B. 1938. Soldiers of the Overland. The Grabhorn Press, San Francisco. 278 p.
1962. William Brown Ide, Bear Flagger. John Howell, San Francisco. 101 p.
- Stewart, George R. 1953. U. S. 40, a cross section of the U. S. A. Houghton-Mifflin, Boston. 309 p.
1953. The opening of the California Trail. Schallenberger's journal. Univ. of Calif. Press, Berkeley.
1960. Ordeal by hunger. Houghton-Mifflin, Boston. 394 p.
1962. The California Trail. McGraw-Hill Co., New York. 339 p.
- Thompson, T. H. and A. A. West. History of Nevada, 1881 (1958 Reprint). Howell-North Press, Oakland. 680 p.
- Truett, Velma Stevens. 1950. On the hoof in Nevada - an ownership history of Nevada cattle and horse brands, 1854 to 1950. Lorrin L. Morrison, Los Angeles. 613 p.
- Ware, Joseph E. 1932. The emigrant's guide to California (reprint from 1849 ed.). Princeton Univ. Press.
- Wren, Thomas. 1904. A history of the State of Nevada. Its resources and people. Lewis Pub. Co., New York. 760 p.

Hydrology

- Hoyt, W. G. and W. B. Langbein. 1955. Floods. Princeton Univ. Press.
- U. S. Dept. of Agriculture. 1955. Water (The yearbook of agriculture). U. S. D. A. 751 p.
- U. S. Forest Service. 1959. Land treatment measures handbook. U. S. F. S.
- U. S. Soil Conservation Service. 1955. Engineering handbook, Supplement A, section 4: Hydrology. U. S. S. C. S.
1961. Watershed protection handbook. U. S. S. C. S.

Bulletins, Periodicals, Papers

Climatology

- Brown, M. 1960. Climates of the States. Nevada. U. S. W. B. Bull. 60-26. 15 p.

- U.S. Weather Bureau. 1930. Climatic summary of the United States to 1930, inclusive. Section 19: Nevada. U.S.W.B. Bull. "W". 34 p.
1952. Climatic summary of the United States for 1931 through 1952. Nevada. U.S.W.B. Bull. 11-22. 27 p.
- 1953-1961. Climatological data. Nevada. U.S.W.B. annuals.
1958. Precipitation data from storage gage stations. (Summary) U.S.W.B. Bull. 70-26 (Nevada). 52 p.
- 1958-1962. Storage gage precipitation data for western United States. U.S.W.B. annuals.

Economics

- Barmettler, Edmund R. 1962. Destination of Nevada cattle. University of Nevada Agri. Exp. Sta. Bull. 224. 8-20.
- Wittwer, E. E. 1960. Nevada agriculture. University of Nevada Agr. Expt. Sta. Bull. 210.

Geology

- Bredehoeft, J. D. 1963. Hydrogeology of the lower Humboldt River Basin, Nevada. Water Resources Bulletin No. 21, Nevada Dept. of Conserv. and Nat. Resour., in cooperation with Desert Research Institute, Univ. of Nevada.
- Ferguson, H. G., Roberts, R. J., and S. W. Muller. 1952. Geology of the Golconda quadrangle, Nevada. U.S. Geological Survey Geologic Quadrangle Map Series.
- Granger, A. E., Bell, M. M., Simmons, G. C., and Florence Lee. 1957. Geology and mineral resources of Elko County, Nevada. Nevada Bureau of Mines Bull. 54, in cooperation with the U.S. Geological Survey.
- Hotz, P. E., and R. Willden. 1961. Preliminary geologic map and sections of the Osgood Mountains quadrangle, Humboldt County, Nevada. U.S. Geological Survey Mineral investigations Field Studies Map MF-161.
- Jones, C. P. 1961. Ground water potentialities in the Crescent Valley, Eureka and Lander Counties, Nevada. Water Resource Bulletin No. 15 (U.S. Geological Survey Water Supply Paper 1581). Nevada Dept. Conserv. and Nat. Resour.
- Lehner, R. E., Tagg, K. M., Bell, M. M. and R. J. Roberts. 1961. Preliminary geologic map of Eureka County, Nevada. Mineral Investigations Field Studies Map MF-178, U.S. Geological Survey, in cooperation with Nevada Bureau of Mines.
- Leopold, L. B., and G. M. Wilman. 1957. River channel patterns: braided, meandering and straight. U.S. Geological Survey Professional Paper 282-B.

Maxey, G. B. and H. A. Shamberger. 1961. The Humboldt River research project, Nevada. Intern'l. Assoc. Scientific Hydrology Publ. No. 57. Ground water in arid zones. 437-454.

Willden, R. 1961. Preliminary geologic map of Humboldt County, Nevada. Mineral Investigations Field Studies Map MF-236. U. S. Geological Survey.

History

Cline, Gloria G. 1960. Peter Skene Ogden's Nevada explorations. Nev. Hist. Soc., Reno. 11-3: 3-11.

Hill, James M. 1916. Notes on some mining districts in eastern Nevada. U. S. G. S. Bull. 648: 106-113.

Kelly, Charles. 1952. Gold seekers on the Hastings Cutoff. Utah Hist. Soc. Quaterly, XX-1: 3-30.

McQuig, John. 1963. Diary, 1869. Nev. Hist. Soc., Reno. VI-2: 2-27.

Rott, Edward H. 1931. Ore deposits of the Gold Circle Mining District, Elko County, Nevada. Univ. of Nev. and Nev. State Bur. of Mines. Bull. 5. 30 p.

U. S. D. A. - Nevada Humboldt River Basin Surv. Field Party. 1962. Chronology of flood years and high water years, Humboldt River. USDA. 46 p.

Hydrology

Blaney, Harry F. 1952. Determining evapotranspiration by phreatophytes from climatological data. Trans. A. G. U. 33-1: 61-66.

Croft, A. R. and L. V. Monniger. 1953. Evapotranspiration and other water losses on some aspen forest types in relation to water available for stream flow. Trans. A. G. U. 34-4: 563-574.

Soils

McCormick, John A. and E. A. Naphan. 1955. Understanding the irrigated soils of Nevada. Univ. of Nev. Agr. Expt. Sta. Circ. B.

U. S. Dept. of Agr. 1958. Salt problems in irrigated soils. Agr. Inf. Bull. 190.

Vegetation

Robertson, J. H., and Clark Torrell. 1958. Phenology as related to chemical composition of plants and to cattle gains on summer ranges in Nevada. Univ. of Nev. Agr. Expt. Sta. Bull. 197. 38 p.

Robertson, J. H., Jensen, E. H., Peterson, R. K., Cords, H. P., and F. E. Kinsinger. 1958. Forage grass performance under irrigation in Nevada. Univ. of Nev. Agr. Expt. Sta. Bull. 196.

Robinson, T. W. 1952. Phreatophytes and their relation to water in western United States. Trans. A.G.U. 33-1: 57-61.

1958. Phreatophytes. U.S.G.S. W.S.P. 1423. 84 p.

State of Nevada, Dept. Conserv. of Nat. Resour. 1960. Progress report, Humboldt River Research project. Nev. Dept. Conserv. and Nat. Resour. 42 p.

State of Nevada, Dept. Conserv. and Nat. Resour. 1961. Second progress report, Humboldt River Research project. Nev. Dept. Conserv. and Nat. Resour. 38 p.

Subcommittee on Phreatophytes, P.S.I.A.C. 1958. A guide to the density survey of bottom land and streambank vegetation. PSIAC. 28 p.

U.S. Forest Service. 1952. Instructions for grazing allotment analysis on national forests of R-4. Region 4, U.S.F.S. 15 p.

U.S. Forest Service. 1960. Range allotment analysis procedures, Chapt. III. Region 4, U.S.F.S. 58 p.

U.S. Soil Conservation Service. 1962. Technical guide excerpt (range), Resource Area 17. U.S.S.C.S., Nevada.

Water Supply and Use

Chief of Engineers, U.S. Army. 1949. Humboldt River and tributaries, Nevada. U.S. Gov't. Printing Office, Washington, D.C.

Hardman, Geo. and H. B. Mason. 1949. Irrigated lands of Nevada. Univ. of Nev. Agr. Expt. Sta. Bull. 183. 57 p.

Houston, C. E. 1950. Consumptive use of irrigation water by crops in Nevada. Univ. of Nev. Agr. Expt. Sta. Bull. 185. 27 p.

1955. Consumptive use of water by alfalfa in western Nevada. Univ. of Nev. Agr. Expt. Sta. Bull. 191. 20 p.

Houston, C. E. and E. A. Naphan. 1952. Consumptive use of water in irrigable areas of the Columbia Basin in Nevada. U.S.D.A. S.C.S. 35 p.

Humboldt Water Distribution District. Streamflow measurements, Humboldt River, Nevada, 1951-1959. Office of the State Engineer, Carson City.

Miller, M. R., Hardman, Geo., and H. G. Mason. 1953. Irrigation water of Nevada. Univ. of Nev. Expt. Bull. 187. 63 p.

- Muth, Edmund. 1952. Humboldt River survey. State of Nevada, Office of the State Engineer, Carson City. 23 p.
1958. Nevada water laws. Title 48 - Water. Chapt. 32-538, inc., also Chapt. 542. State of Nevada, Dept. Conserv. and Nat. Res. 117 p.
- U.S. Dept. of Agr. 1958. Determining the quality of irrigation water.
- U.S. Geological Survey. 1951-1960. Surface water supply of the United States. Part 10, The Great Basin. U.S.G.S. W.S.P. annuals.
1960. Compilation of records of surface water of the United States through September 1950. Part 10, The Great Basin. U.S.G.S. W.S.P. 1314. 485 p.
- U.S. Geological Survey - Nevada. 1961. The ground water situation in Nevada. Ground-Water Resources - Information Series Report 1. State of Nev., Dept. of Conserv. and Nat. Resources, Carson City. 20 p.
- Young, Arthur A. and H. F. Blaney. 1942. Use of water by native vegetation. Cal. Dept. Public Works, Div. Water Resources Bull. 50. 154 p.

Newspapers

Daily Silver State - Winnemucca, Nevada

Elko Daily Free Press - Elko, Nevada

Elko Independent - Elko, Nevada

Eureka Sentinel - Eureka, Nevada

Humboldt Register - Unionville, Nevada. Winnemucca, Nevada

Humboldt Star - Winnemucca, Nevada

Nevada State Herald - Wells, Nevada

Nevada State Journal - Reno, Nevada

Reno Evening Gazette - Reno, Nevada

APPENDIX I

Pertinent elaborative material of value to the general reader, for his reference and guidance in the use of the sub-basin report.

CONTENTS

	<u>Page</u>
<u>Soils</u>	
Soils Description -----	73
Soils Tables -----	76
Definitions -----	85
<u>Annual Water Balance Study - 80 Percent Frequency (Chance) -----</u>	<u>88</u>
<u>Appendix II Table of Contents only; text not included with this report --</u>	<u>95</u>
<u>Maps</u>	
Land Status	
Soils, Range Sites, and Forage Production	
Land Use and Phreatophytes	

SOILS DESCRIPTION

The generalized soil survey of the Battle Mountain Sub-Basin shows the location and distribution of different kinds of soils by associations of Great Soil Groups. Each Great Soil Group includes a number of soils with similar internal development. Great Soil Groups mapped in the survey include:

Alluvial Soils (Symbol: A)

These are the soils that consist of essentially recent stream-laid deposits: alluvial fans, floodplains, terraces and basins. They have essentially no profile development, but a little organic matter may have accumulated. They are usually deep, stratified, variable with regard to drainage class, and occur under many different climates.

Brown Soils (Symbol: B)

These are the soils which have dark brownish A horizons about six inches thick, textural B horizons 10 to 15 inches thick, and calcareous parent material of variable thickness. Some of these soils have cemented calcium carbonate layers in the C horizon and some may have the C horizon resting on bedrock. They are usually moderately deep to deep, well drained, and occur under a cool semi-arid climate with an average precipitation of 10 to 14 inches. Most of the Brown Soils in the Battle Mountain Sub-Basin occur at elevations above 5,000 feet, in the uplands.

Chestnut Soils (Symbol: C)

These soils have dark grayish brown to very dark grayish brown A horizons about six to eight inches thick, textural B horizons 10 to 15 inches thick, and parent material that may or may not be calcareous. These soils usually have darker A horizons, more organic matter, and have been more strongly leached than have the Brown Soils. The parent material may or may not rest on bedrock. They are usually moderately deep to deep, well drained, and occur in a cool semi-arid climate with an average precipitation of about 14 to 18 inches. Most of the Chestnut Soils in the Battle Mountain Sub-Basin occur at elevations above 5,500 feet, in the uplands.

Calcisols (Symbol: G)

These soils occur on highly calcareous parent material in the arid and semi-arid regions. They have developed where leaching is limited, but have formed under good to excessive drainage conditions. They include soils in which the calcium carbonate has accumulated to form a prominent Cca or Dca horizon near the lower depth of wetting. They have a light gray-brown A or A1 horizon, about 10 to 15 inches thick, which becomes lighter colored with depth. They are moderately deep, well drained, and occur with an average annual precipitation of about eight to 12 inches at elevations below 7,000 feet.

Desert Soils (Symbol: D)

These are well to imperfectly drained soils in a cool arid climate. They have a thin light-colored A horizon (less than six inches) that is neutral to mildly alkaline, low in organic matter, with platy structure and frequently vesicular porosity. The B horizon (six to 14 inches) usually contains more clay, and is as dark or darker than the A, is neutral to strongly alkaline, and may be calcareous. A layer of calcium-carbonate accumulation, that may be cemented, occurs in or below the B horizon at a depth of one to three feet. They are moderately deep, medium and gravelly medium textured and occur in a four to eight inch precipitation zone.

Humic Gley Soils (Symbol: H)

These are the dark brown or black meadow soils that grade into lighter colored or rust-mottled grayish soil at depths of one to two feet. They are imperfectly to poorly drained, usually with seasonal fluctuating high water table, and occur along stream floodplains where they are subject to overflow. They occur in a cool semi-arid climate, and are found in the Battle Mountain Sub-Basin at elevations mostly below 6,000 feet.

Lithosols (Symbol: L)

These soils have an incomplete profile, or no clearly expressed morphology. They are shallow (less than 10 to 15 inches), and consist of freshly and imperfectly weathered masses of hard rock or hard rock fragments, and are largely confined to steeply sloping lands. In the higher rainfall areas of the sub-basin, some of these soils may have dark A horizons. They are usually excessively drained.

Regosols (Symbol: R)

These are soils which consist of deep unconsolidated deposits, in which few or no clearly expressed soil characteristics have developed. They are largely confined to colluvial accumulations on steep mountain slopes. Under eight to 10 inches of rainfall the Regosols may have only a weakly developed A horizon; while in higher rainfall areas they may have well developed dark A horizons six to 14 inches or more thick. In mountainous areas these soils may be underlain by bedrock 15 to 20 inches below the soil surface.

Sierozems (Symbol: S)

These are soils with a pale grayish or light brownish surface and textural B horizons closely related in color to the surface soil. They are usually calcareous in the B horizon, and frequently also in the surface soil. They quite often have a cemented calcium-carbonate hardpan at shallow to moderate depths below the B horizon. The B horizon in the Sierozem Soils in this sub-basin is usually weakly developed and difficult to identify. In mountainous areas the Sierozems may be underlain by bedrock at moderate depths. These soils are found in a semi-arid cool climate, with an average annual precipitation of about eight to 10 inches, and mostly at elevations below 6,000 feet.

Solonchak Soils (Symbol: W)

These are saline, poorly to very poorly drained soils that are high in soluble salts at or near the surface. The A horizon is thin (less than four inches), light colored, and low in organic matter. They have no clearly expressed soil layers, and are usually associated with high water table. They are moderately deep to deep, medium and moderately fine textured and occur in a five to eight inch precipitation zone.

Solonetz (Symbol: Y)

These are imperfectly drained soils with a very few inches of light grayish or brownish surface soil underlain by a hard columnar fine-textured horizon that is high in exchangeable sodium. They occur on floodplains, terraces, and some alluvial fans, usually as small areas associated with saline-alkali Alluvial Soils, Humic Gley Soils, and Calcium Carbonate Solonchaks.

Rockland (Symbol: Z)

These are essentially nonsoil areas, consisting of hard rock and hard rock fragments of granite, limestone and lava formations, which are extremely steep and inaccessible to livestock. They occur as outcrops, bluffs and cliffs with some talus areas below. Little or no weathering has taken place for soil formation. Vegetation on these areas is limited to natural fractures in the rock or small areas of deposited soil material.

Mapping Units

Mapping units on the generalized soil survey map of the Battle Mountain Sub-Basin are associations of phases of Great Soil Groups that reflect characteristics of soils significant to use and management. Each mapping unit symbol includes the designation of approximate composition for each Great Soil Group that comprises the association.

Example: L1-C1-R1
60-20-20

SOILS TABLES

The following tables, 4 and 5, show the general soil characteristics and the interpretations for each Great Soil Group phase which was mapped in the sub-basin.

Table 4. -- Soil characteristics, Battle Mountain Sub-Basin

Soil Phase	Depth	Surface	Texture	Subsoil	Slope %	Erosion	Salt & alkali	Drainage	Remarks
A1	:Deep	:Coarse to medium	:Medium to moderately fine	:Medium to moderately fine	:2-8	:Slight	:None	:Well to Moderately well	:10% blowsand de-position
A2	:Deep	:Medium and gravelly medium	:Medium	:Medium	:2-15	:Slight	:None	:Well	:10% stony soils, seedable
A3	:Deep	:Medium	:Medium	:Medium	:2-4	:Slight	:Slight	:Well to moderately well	:Well to moderately well
A4	:Deep	:Medium	:Medium	:Medium	:0-2	:Slight	:Slight	:Imperfect	:Overflowed
A5	:Deep	:Medium	:Medium	:Medium	:0-2	:Slight	:None to Slight	:Moderately well	:Overflowed, some gully
A6	:Deep	:Medium to moderately fine	:Medium to moderately fine	:Medium to moderately fine	:0-2	:Slight	:Moderate	:Imperfect	:Imperfect
A7	:Shallow to moderately deep	:Medium and gravelly medium	:Gravelly medium and medium	:Gravelly medium and medium	:0-4	:Slight	:None	:Somewhat excessive	:Small areas suited to seeding
A8	:Deep	:Medium	:Medium	:Medium	:2-8	:Slight	:None	:Moderately well	:20% stony soils
A12	:Deep	:Medium	:Medium	:Medium to moderately fine	:0-4	:Slight	:None to slight	:Imperfect	:Small areas of range
A13	:Deep	:Medium to moderately fine	:Medium to moderately fine	:Medium to moderately fine	:0-2	:Slight	:Moderate to strong	:Imperfect	:Small areas of cropland
A14	:Deep	:Medium	:Medium	:Medium	:0-2	:Slight	:None to slight	:Moderately well	:10% moderately saline and alkali, occasionally over-flowed

Continued

Table 4. -- Soil characteristics, Battle Mountain Sub-Basin -- Continued

Soil Phase :	Depth :	Surface :	Texture :	Slope : :range %:	Erosion :	Salt & alkali :	Drainage :	Remarks
B1	: Moderately : deep to deep	: Medium	: Medium to mod- : erately fine	: 30-50	: Slight : 15% mod.:	: None	: Well	: Hill creep
B3	: Moderately : deep to deep	: Medium, stony : medium, and very : stony medium	: Medium, moder- : ately fine and : fine	: 4-50	: Slight : 10% mod.:	: None	: Well	: 5-15% stony soils, : 10% deep
B4	: Deep	: Stony medium and : moderately fine	: Moderately fine : and fine	: 20-40	: Slight : 10% mod.:	: None	: Well	: 5% Chestnut, : 5% Sierozem
B5	: Moderately : deep to deep : over bedrock	: Medium	: Moderately fine : and fine	: 10-30	: Slight : 10% mod.:	: None	: Well	: 10% stony medium, : 25% seedable
B10	: Moderately : deep	: Medium stony	: Fine over hardpan	: 10-60	: Slight : 5% mod.:	: None	: Well	
B11	: Moderately : deep	: Medium	: Fine over hardpan	: 3-10	: Slight : 5% mod.:	: None	: Well	: 80% seedable
C1	: Moderately : deep to deep	: Stony medium and : medium	: Medium to mod- : erately fine	: 30-50	: Slight : 15% mod.:	: None	: Well	: 10% very stony, : 10% deep Chestnut : Soils
C2	: Moderately : deep to deep	: Medium	: Medium to mod- : erately fine	: 4-30	: Slight : 10% mod.:	: None	: Well	: 15-25% stony soils
C4	: Deep	: Medium	: Moderately fine : to fine	: 16-50	: Slight : 5% mod.:	: None	: Well	: 20% stony soils
D1	: Moderately : deep over : gravels	: Medium and grav- : elly medium	: Medium and : gravelly medium	: 2-10	: Slight	: None	: Well	
D2	: Moderately : deep over : cemented pan	: Medium and grav- : elly medium	: Medium and : gravelly medium	: 0-4	: Slight	: None	: Well	

Continued

Table 4. -- Soil characteristics, Battle Mountain Sub-Basin -- Continued

Soil Phase :	Depth :	Surface :	Texture :	Slope : :range %:	Erosion : : & alkali :	Salt : : Drainage :	Remarks :
G1	: Moderately : deep over al- : kali soluble : pan	: Medium and grav- : elly medium : :	: Medium and : gravelly medium : :	: 3-10 : : :	: Slight : 20% mod.: : 10% sev. : :	: None : : :	: 10% stony soils : 40% seedable : :
G2	: Moderately : deep	: Medium and grav- : elly medium	: Medium and : gravelly medium	: 20-40 :	: Slight : 20% mod.: :	: None : :	: 10% stony soils : :
G3	: Shallow	: Gravelly and stony : medium	: Gravelly and : stony medium	: 10-30 :	: Moderate : 10% sev. : :	: None : :	: Well : :
H1	: Deep	: Medium	: Medium	: 0-2 :	: Slight :	: Slight :	: Imperfect : Overflowed
H2	: Deep	: Medium	: Medium	: 0-2 :	: Slight :	: None :	: Imperfect : :
H4	: Deep	: Medium	: Medium to mod- : erately fine	: 0-2 :	: Slight :	: None :	: Poor : Overflowed
H6	: Deep	: Medium and mod- : erately fine	: Medium and mod- : erately fine	: 0-2 :	: Slight :	: Slight to : moderate : :	: Imperfect : Overflowed
L1	: Shallow over : bedrock	: Stony and rocky : medium	: Stony and rocky : medium	: 50-70 :	: Slight : 20% mod.: :	: None : :	: Excessive : 10% rock outcrop
L5	: Shallow over : bedrock	: Very gravelly stony: : moderately coarse :	: Very gravelly stony: : moderately coarse :	: 30-60 :	: Moderate : 10% sev. : :	: None : :	: Excessive : 10% rockland
L6	: Shallow over : bedrock	: Stony and gravelly : medium	: Stony and gravelly : medium	: 20-50 :	: Slight : 10% mod.: :	: None : :	: Excessive : 10% rockland
L10	: Shallow over : bedrock	: Stony and rocky : medium	: Stony and rocky : medium	: 30-60 :	: Moderate : 10% sev. : :	: None : :	: Excessive : 10% rock outcrop
L12	: Shallow over : bedrock	: Stony medium :	: Stony medium :	: 16-30 :	: Slight : 5% mod. : :	: None : :	: Somewhat : 10% rock outcrop
R1	: Moderately : deep to deep	: Stony and gravelly : elly medium	: Stony and grav- : elly medium	: 30-60 :	: Slight : 15% mod.: :	: None : :	: Somewhat : excessive : :

Continued

Table 4. -- Soil characteristics, Battle Mountain Sub-Basin -- Continued

Soil Phase :	Depth :	Surface :	Texture :	Slope : :range %:	Erosion :	Salt & alkali :	Drainage :	Remarks
R5	: Moderately : deep to deep	: Stony and gravelly : medium	: Medium	: 30-50	: Slight : 15% mod.:	: None	: Somewhat : excessive	:
R6	: Moderately : deep to deep	: Stony and gravelly : medium	: Medium	: 15-30	: Slight : 50% mod.:	: None	: Well	:
R11	: Deep	: Stony medium	: Medium	: 40-60	: Slight : 10% mod.:	: None	: Somewhat : excessive	: 15% rock outcrop : and very stony
R12	: Moderately : deep to deep	: Very gravelly and : stony medium	: Very gravelly and : stony medium	: 50-65	: Slight : 20% mod.:	: None	: Somewhat : excessive	:
S2	: Shallow to : moderately : deep	: Medium and grav- : elly medium	: Medium	: 2-8	: Slight : 20% mod.:	: None	: Well	:
S3	: Moderately : deep to deep	: Stony medium	: Medium	: 15-30	: Slight : 15% mod.:	: None	: Well	:
S4	: Moderately : deep to deep	: Medium	: Medium	: 2-30	: Moderate : gullying	: None	: Well	: 5% stony soils
S5	: Moderately : deep to deep	: Medium and grav- : elly medium	: Medium	: 8-15	: Moderate : gullying : 20% sev.:	: None	: Well	: 5% stony soils
S6	: Shallow to : moderately : deep	: Medium	: Medium	: 8-15	: Moderate : gullying	: Slight to : strong	: Well	: 10% stony soils
S7	: Moderately : deep to deep	: Medium and mod- : erately coarse	: Medium and mod- : erately coarse	: 2-8	: Slight : 15% mod.:	: None	: Well	: 15% stony soils
S8	: Moderately : deep	: Gravelly medium	: Gravelly medium	: 20-40	: Moderate	: None	: Well	: 10% stony soils

Continued

Table 4. -- Soil characteristics, Battle Mountain Sub-Basin -- Continued

Soil Phase	Depth	Texture		Slope : range %	Erosion	Salt & alkali	Drainage	Remarks
		Surface	Subsoil					
S9	Moderately deep	Medium	Medium	10-30	Slight	None	Well	10% moderately deep gravelly medium Sierozem, 10% deep Sierozem
S10	Moderately deep	Medium	Moderately fine	10-50	Slight	None	Well	50% seedable
					15% mod.			
W1	Moderately deep to deep	Medium and moderately fine	Medium and moderately fine	0-2	Slight	Strong	Poor to very poor	Overflowed
					20% mod.			
Y1	Deep	Medium and moderately fine	Moderately fine	0-3	Slight	Moderate	Imperfect to moderately	
		erately fine	to fine		5% sev.	to strong	moderately	
							well	
Z	Rockland	-----	-----	-----	-----	-----	-----	-----

Source: Humboldt River Basin Field Party.

Table 5. -- Interpreted soil characteristics, Battle Mountain Sub-Basin

Soil Phase	zone	erosion hazard	AWHC 1/2 (inches)	precip.	Soil Hydro-logic Group	Capability	Major land use	Dominant vegetation
A1	6-8	Slight	12		C	Vlls	Range	:Big sage-grass
A2	6-10	Slight	8		B	Vlc	Range	:Big sage-shadscale-grass
A3	6-8	Slight to moderate	10		C	Vllc	Range	:Shadscale-budsage, squirreltail
A4	6-8	Slight	10		B	Illw	Irrigated crops	:Alfalfa-small grain
A5	6-10	Slight	9		C	llw	Irrigated crops and range	:Big sage-greasewood-grass
A6	6-8	Slight	12		D	Vlls	Range and irrigated crops	:Greasewood-saltgrass, rabbit-brush-saltgrass
A7	6-8	Moderate	3		B	Vlls	Range	:Big sage-rabbitbrush-grass
A8	6-8	Moderate	12		B	llw	Cropland and range	:Big sage-grass
A12	8-10	Slight	12		B	llw	Cropland	:Big sage-greasewood, rabbit-brush-grass
A13	6-8	Slight	12		D	IVw	Range	:Greasewood-saltgrass
A14	6-8	Slight	10		B	llw	Irrigated crops and range	:Big sage-grass, greasewood-grass
B1	6-25	Moderate	4		C	Vlle	Range	:Big sage-grass, juniper
B3	8-12	Moderate	8		C	Vlc	Range	:Big sage-low sage-grass
B4	6-12	Slight	8		C	Vlls	Range	:Big sage-grass
B5	6-10	Slight	6		C	Vlls	Range	:Big sage-grass
B10	8-10	Slight	5		D	Vlls	Range	:Low-sage-grass, big sage-grass
B11	8-10	Slight	5		D	Vls	Range	:Low sage-grass

Continued

Table 5. -- Interpreted soil characteristics, Battle Mountain Sub-Basin -- Continued

Soil	Precip zone	Erosion hazard	AWHC 1/ (inches)	Hydro-logic Group	Capability	Dominant vegetation
Phase	(inches)			sub	class	Major land use
C1	8-25	Moderate	6	C	VIIe	Range
C2	8-10	Moderate	8	C	VIc	Range
C4	8-12	Slight	8	C	VIIe	Range
D1	6-10	Slight	4	D	VII	Range
D2	6-8	Slight	4	D	VII	Range
G1	6-10	Moderate	5	D	VIc	Range
G2	6-8	Slight	5	D	VIIe	Range
G3	6-10	Slight	3	D	VIIIs	Range and woodland
H1	6-8	Slight	12	B	IIW	Meadow hayland and pasture
H2	6-10	Slight	12	B	IIW	Meadow hayland and pasture
H4	6-8	Slight	10	C	IIIW	Meadow hayland and pasture
H6	6-8	Slight	10	B	IVW	Range and meadow
L1	6-25	Moderate	1.5	D	VIIIs	Range and watershed
L5	8-12	Severe	1.5	D	VIIIs	Range
L6	8-12	Severe	1.5	D	VIIIs	Range
L10	8-25	Severe	1.5	D	VIIIs	Range and watershed
L12	8-18	Slight	1.5	D	VIIIs	Range and watershed
R1	6-25	Moderate	6	C	VIIe	Range and watershed
R5	10-12	Moderate	6	C	VIIe	Range
R6	8-12	Moderate	4	C	VIIe	Range
R11	8-15	Moderate	7	C	VIIe	Range

Continued

DEFINITIONS

HYDROLOGIC SOIL GROUPS

Watershed soil determinations are used in the preparation of hydrologic soil cover complexes, which in turn are used in estimating direct runoff. Four major soil groups are used. The soils are classified on the basis of intake of water at the end of long-duration storms occurring after prior wetting and opportunity for swelling and without the protective effects of vegetation.

- Group A - Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep, well to excessively well drained sand or gravel. These soils have a high rate of water transmission and would result in a low runoff potential.
- Group B - Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.
- Group C - Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of (1) soils with a layer that impedes the downward movement of water, or (2) soils with moderately fine to fine texture and slow infiltration rate. These soils have a slow rate of water transmission.
- Group D - Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clay soils with a high swelling potential; (2) soils with a high permanent water table; (3) soils with a claypan or clay layer at or near the surface; and (4) shallow soils having a very slow rate of water transmission.

LAND USE CAPABILITY CLASSES AND SUBCLASSES

The capability classification is a practical grouping of soils. Soils and climate are considered together as they influence use, management, and production on the farm or ranch.

The classification contains two general divisions: (1) land suited for cultivation and other uses; and (2) land limited in use and generally not suited for cultivation. Each of these broad divisions has four classes which are shown by a number. The hazards and limitations in use increase as the class number increases. Class I has few hazards or limitations, or none, whereas Class VIII has a great many.

Capability classes are divided into subclasses. These show the principal kinds of conservation problems involved. The subclasses are "e" for erosion, "w" for wetness, "s" for soil, and "c" for climate.

Capability classes and subclasses, in turn, may be divided into capability units. A capability unit contains soils that are nearly alike in plant growth and in management needs.

Land Suited for Cultivation and Other Uses

- | | |
|-----------|---|
| Class I | Soils in Class I have few or no limitations or hazards. They may be used safely for cultivated crops, pasture, range, woodland or wildlife. |
| Class II | Soils in Class II have few limitations or hazards. Simple conservation practices are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife. |
| Class III | Soils in Class III have more limitations and hazards than those in Class II. They require more difficult or complex conservation practices when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife. |
| Class IV | Soils in Class IV have greater limitations and hazards than Class III. Still more difficult or complex measures are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife. |

Land Suited for Range and Other Uses

- Class V Soils in Class V have little or no erosion hazard but have other limitation that prevent normal tillage for cultivated crops. They are suited to pasture, woodland, range or wildlife.
- Class VI Soils in Class VI have severe limitations or hazards that make them generally unsuited for cultivation. They are suited largely to pasture, range, woodland, or wildlife.
- Class VII Soils in Class VII have very severe limitations or hazards that make them generally unsuited for cultivation. They are suited to grazing, woodland, or wildlife.
- Class VIII Soils and land forms in Class VIII have limitations and hazards that prevent their use for cultivated crops, pasture, range, or woodland. They may be used for recreation, wildlife, or water supply.

ANNUAL WATER BALANCE STUDY - 80% FREQUENCY (CHANCE)

Annual water balance, as used in these studies, is the evaluation of a portion of the hydrologic cycle. The cycle starts with incident precipitation on the watershed, and ends with the runoff, both surface and subsurface flow, after subtracting water uses and losses.

The annual water balance was calculated for an 80 percent frequency (80 percent chance, expected to be equaled or exceeded eight out of 10 years). This frequency was used because normally such a water supply would be the quantity needed to justify land and irrigation improvements on ranches growing high-yielding forage crops. In Kelly Creek, Izzenhood, and Boulder Flat Watersheds, however, the 80 percent frequency concept has only limited value in defining the total available water supply. The quantity of ground water storage in these drainages is no doubt large in relation to yield. The usable water supply for any year would therefore approach the average annual yield.

Values obtained using this procedure are approximations. Accuracy would depend on the reliability of the basic soils, vegetation, and hydrologic data used, and would normally be in the range of 60 to 90 percent.

Water yield data are not available on the watersheds in Battle Mountain Sub-Basin. U. S. Geological Survey streamflow records for 22 years (1919-1923 and 1946-1964) at the Rock Creek gage were used to estimate the 80 percent discharge from that drainage. Stream gage records at Palisade, Battle Mountain, and Comus were used to check the water uses and losses in the Humboldt reach.

The available information used for determining precipitation in the watershed areas consisted of recording stations at Palisade (24 years), Beowawe (92 years), Battle Mountain (93 years), Golconda (81 years), Emigrant Pass (nine years), Tuscarora (50 years), and Midas (10 years). In addition, there are three storage gages, one on Willow Creek Summit (10 years), another at the Getchell Mine (four years), and the third at the Kelly Creek Ranch (four years), and one cooperative snow survey course located at Midas (24 years).

These data give an indication of the annual precipitation. The precipitation used in the water balance studies was determined as the quantity needed to produce the 80 percent frequency (chance) flow, after subtracting the water uses and losses.

The flow from all springs was assumed to be part of the gross water yield (estimated available water prior to agricultural and phreatophytic uses) from the sub-basin.

A flow diagram of water yields and depletion, with quantities in acre-feet, is shown in figure 1. Table 6 is a summary of the water balance studies by elevation zones for watersheds. The difference in water yield, inches per acre, is caused by the difference in watershed characteristics. These characteristics include (1) precipitation; (2) soil development; (3) condition and species of plant cover; and (4) physical features of the drainage (exposure, topography, slope, etc.).

During an 80 percent frequency (chance) year part of the water used by phreatophytes and pumped for irrigation (56,200 acre-feet) would no doubt come from ground water storage. This is based on an analysis using the summation of the water yields and inflows, as compared to the discharge at the Comus gage, and minimum water requirements for phreatophytes and irrigated crops.

For the main stem of the Humboldt River the difference between water yields plus inflow (124,700) and water uses and losses (73,200) was calculated to be 51,500 acre-feet, for an 80 percent frequency (chance). This quantity would be available for discharge at Comus. The discharge at the Comus gage, however, is about 74,500 acre-feet (80 percent frequency), and would therefore indicate that the difference, 23,000 acre-feet, would come from another source, presumed to be ground water storage. The ground water storage would be recharged during higher-yielding years.

The annual water balance inventories by watersheds were made to find answers to the following questions:

1. What is the gross water yield of the watersheds in the sub-basin?
Gross water yield, for the purpose of this study, is the estimated available water, both surface and subsurface, prior to agricultural and phreatophytic use. Generally, this water yield is estimated for a stream or streams at a point above the highest diversion for the main body of irrigated land on a flood plain of a valley.
2. What is the magnitude of water use and loss by each of the major ground cover types?
3. Where are the water-yielding areas in the sub-basin and in each watershed?
4. Can vegetal manipulation be used to increase water supply for beneficial use?

The sub-basin was divided into eight watersheds in order to obtain a more accurate estimate of water yield, water uses and losses. They are: (1) Kelly Creek; (2) Izzenhood; (3) Willow Creek; (4) Squaw Valley; (5) Antelope Creek; (6) Boulder Flat; (7) Palisade-Battle Mountain; and (8) Battle Mountain-Comus (see sketch map, figure 3).

The results of the water balance studies indicate the following:

1. The 80 percent gross water yield (surface and subsurface) from the sub-basin was estimated to be 21,500 acre-feet.
2. The estimated surface and ground water uses and losses are as follows:

	<u>Acres</u>	<u>Water use acre-feet</u>
Irrigated crops	28,000	29,300
Phreatophytes	213,000	91,000
Reservoir evaporation	-----	300
Direct evaporation from surface water	-----	2,000
Evaporation from playas	-----	1,300
Municipal water	-----	300
Total		<u>124,200</u>

3. The drainages from the Tuscarora Mountains contribute about 50 percent of the water yield in the sub-basin; 25 percent of the yield comes from the Osgood and Snowstorm Mountains.
4. Phreatophytes of low economic value, consisting of willow, wild rose, greasewood, rabbitbrush, saltgrass, and seepweed use an estimated 52,600 acre-feet of water. A large part of this water could be put to beneficial use by controlling or replacing some of these water-wasting plants.

Figure 3. -- Watersheds delineated for water balance studies, Battle Mountain Sub-Basin



- L E G E N D**
- ① Kelly Creek Watershed
 - ② Squaw Valley Watershed
 - ③ Willow Creek Watershed
 - ④ Boulder Creek Watershed
 - ⑤ Antelope Creek Watershed
 - ⑥ Izzenhood Watershed
 - ⑦ Battle Mountain to Comus Watershed
 - ⑧ Palisade to Battle Mountain Watershed

10 0 10
SCALE IN MILES

Table 6. -- Summary of Water Balance Studies by elevation zones for watersheds in Battle Mountain Sub-Basin for an 80% frequency (chance) 1/2/

Willow Creek			Squaw Valley			Antelope Creek		
Elevation zone	Acres	Water Yield	Acres	Water Yield	Acres	Water Yield	Acres	Water Yield
(feet)	: in./ac.	: acre-feet	: in./ac.	: acre-feet	: in./ac.	: acre-feet	: in./ac.	: acre-feet
8,000-8,590	300	4.40	1,700	4.30	610	-----	-----	-----
7,000-8,000	6,600	2.69	8,700	2.44	1,770	1,500	2.32	290
6,000-7,000	33,800	.91	50,400	.78	3,290	39,700	.35	1,150
5,000-6,000	35,300	-----	129,200	.01	130	220,200	.01	170
4,000-5,000	-----	-----	-----	-----	-----	36,600	-----	-10
Total	76,000	4,100	190,000	5,800	-----	298,000	-----	1,600
Gross Water Yield:			5,800			1,600		
Inflow:			3,600			5,500		
Uses and losses:			Willow Creek			Squaw Valley		
Irrigated crops	(50 ac.)	- 50	(2,400 ac.) - 2,900			(150 ac.) - 200		
Phreatophytes	(200 ac.)	- 100	(1,900 ac.) - 1,000			(3,600 ac.) - 1,200		
Reservoir evaporation		- 350	-----			-----		
Evaporation from playas		-----	-----			-----		
Outflow: Squaw Valley		3,600	Antelope Creek			Boulder Flat		
Use from ground water storage:		-----	5,500			5,700		

Continued

Table 6. -- Summary of Water Balance Studies by elevation zones for watersheds in Battle Mountain Sub-Basin for an 80% frequency (chance) 1/ 2/ -- Continued

Elevation zone (feet)	Boulder Flat		Izenhoo		Kelly Creek	
	Acres	Water Yield : in./ac. : acre-feet	Acres	Water Yield : in./ac. : acre-feet	Acres	Water Yield : in./ac. : acre-feet
8,000-8,680	500	4.32 180	-----	-----	1,000	4.00 300
7,000-8,000	4,700	2.63 1,030	400	1.50 50	16,600	2.20 3,050
6,000-7,000	29,200	.58 1,390	15,700	.60 780	31,400	.59 1,550
5,000-6,000	85,900	.02 150	38,300	.14 460	86,500	.08 570
4,000-5,000	112,700	----- -50	136,600	----- -90	185,500	----- -170
Total	233,000	2,700	191,000	1,200	321,000	5,300
Gross Water Yield:		2,700		1,200		5,300
Inflow: Antelope Creek		5,700		-----		-----
Uses and losses:						
Irrigated crops	(300 ac.) - 500		(100 ac.) - 200		(5,800 ac.) - 4,900	
Phreatophytes	(38,700 ac.) -17,200		(29,700 ac.) -8,800		(36,300 ac.) -12,700	
Reservoir evaporation	-----		-----		-----	
Evaporation from playas	-----		- 900		-----	
Outflow: Humboldt River Reach	2,900		-----		-----	
Use from ground water storage:	12,200		8,700		12,300	

Continued

Table 6. -- Summary of Water Balance Studies by elevation zones for watersheds in Battle Mountain Sub-Basin for an 80% frequency (chance) 1/ 2/ -- Continued

Elevation zone (feet)	Palisade to Battle Mountain		Battle Mountain to Comus	
	Acres	Water Yield : in./ac. : acre-feet	Acres	Water Yield : in./ac. : acre-feet
8,000-8,580	-----	---	400	1.20 40
7,000-8,000	1,900	.82 130	8,600	.23 170
6,000-7,000	26,300	.13 390	9,000	---- 10
5,000-6,000	94,700	.01 120	22,600	---- 20
4,360-5,000	122,100	---	157,400	---- -40
Total	245,000	600	198,000	200
Gross Water Yield:		600		200
Inflow: Humboldt River at Palisade	116,000		Humboldt River at Battle Mountain	98,000
Pine Creek	5,000		-----	-----
Rock Creek	2,900		-----	-----
Uses and losses:				
Irrigated crops	(11,600 ac.) -12,700		(7,600 ac.) -7,800	
Phreatophytes	(41,000 ac.) -23,000		(61,600 ac.) -27,000	
Direct evaporation from surface water	-1,400		-600	
Evaporation from playas	-400		---	
Municipal water	-----		-300	
Use from ground water storage	11,000		12,000	
Outflow: At Battle Mountain				
USGS gage	98,000		At Comus USGS gage	74,500

1/ Values in this table when referred to in the text are rounded.

2/ See Water Supply Data, Appendix II.

Source: Humboldt River Basin Field Party.

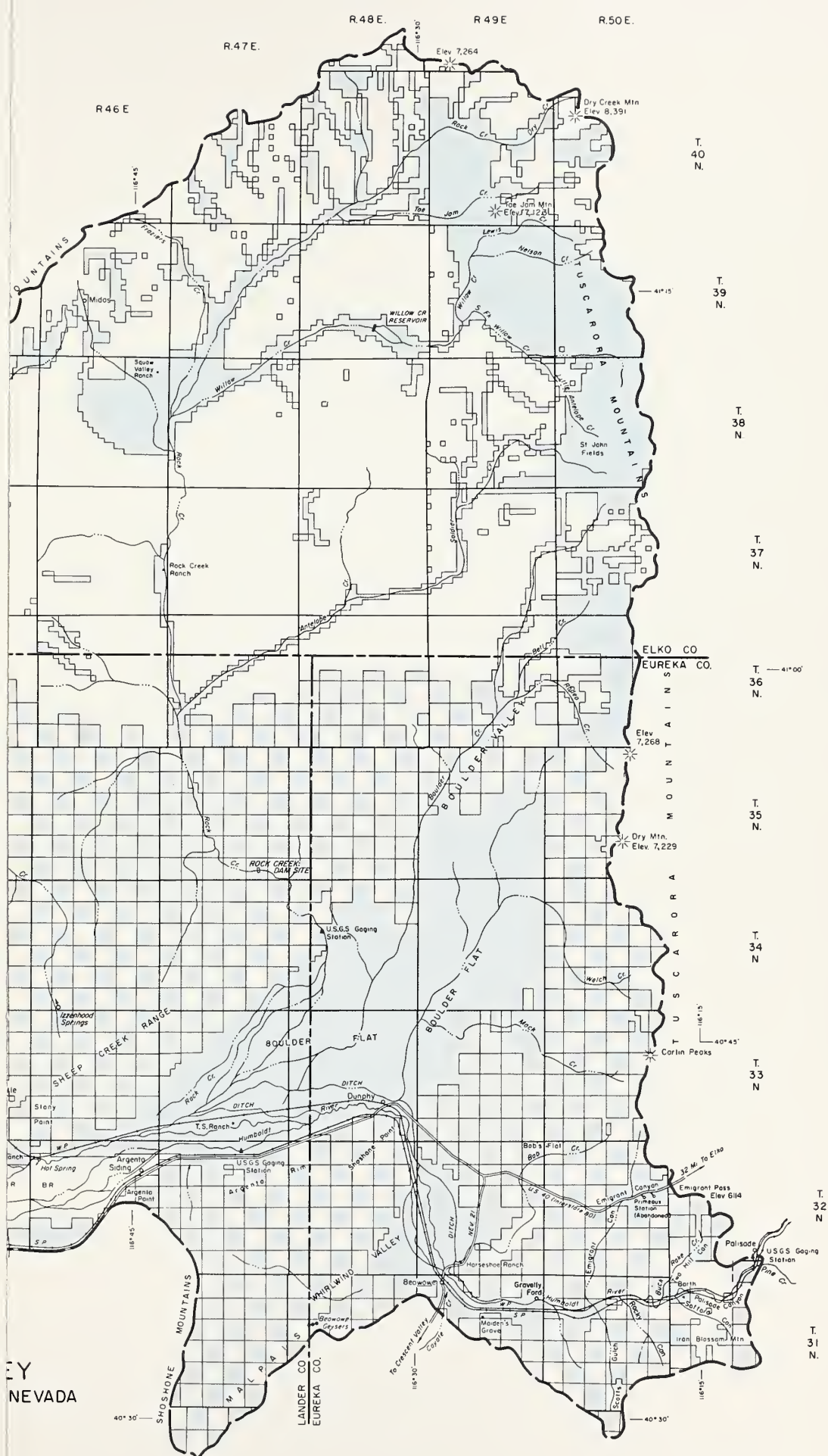
APPENDIX II

This appendix is produced in a relatively limited number of copies. It contains material germane to the Battle Mountain Sub-Basin but which, because of its detailed or technical nature, is not attached to copies for general distribution.

Such material, however, has potential value as an information reservoir for technicians, administrators, and resource managers concerned with the Battle Mountain Sub-Basin.

CONTENTS

<u>Historical Information</u>	Section	I
<u>Geology</u>	Section	II
<u>Soils Description</u>	Section	III
<u>Guide to Range Condition Classification</u>	Section	IV
<u>Water Supply Data</u>	Section	V
Hydrology		
Annual Water Balance Study - 80 percent frequency		
Classification of Hydrologic Conditions, the		
Humboldt River Basin Survey		
<u>Fire Protection Plans</u>	Section	VI
<u>Present Fire Protection Plans</u>		
National Land Reserve		
<u>Plans to Meet Future Fire Protection Needs</u>		
National Land Reserve		



L E G E N D

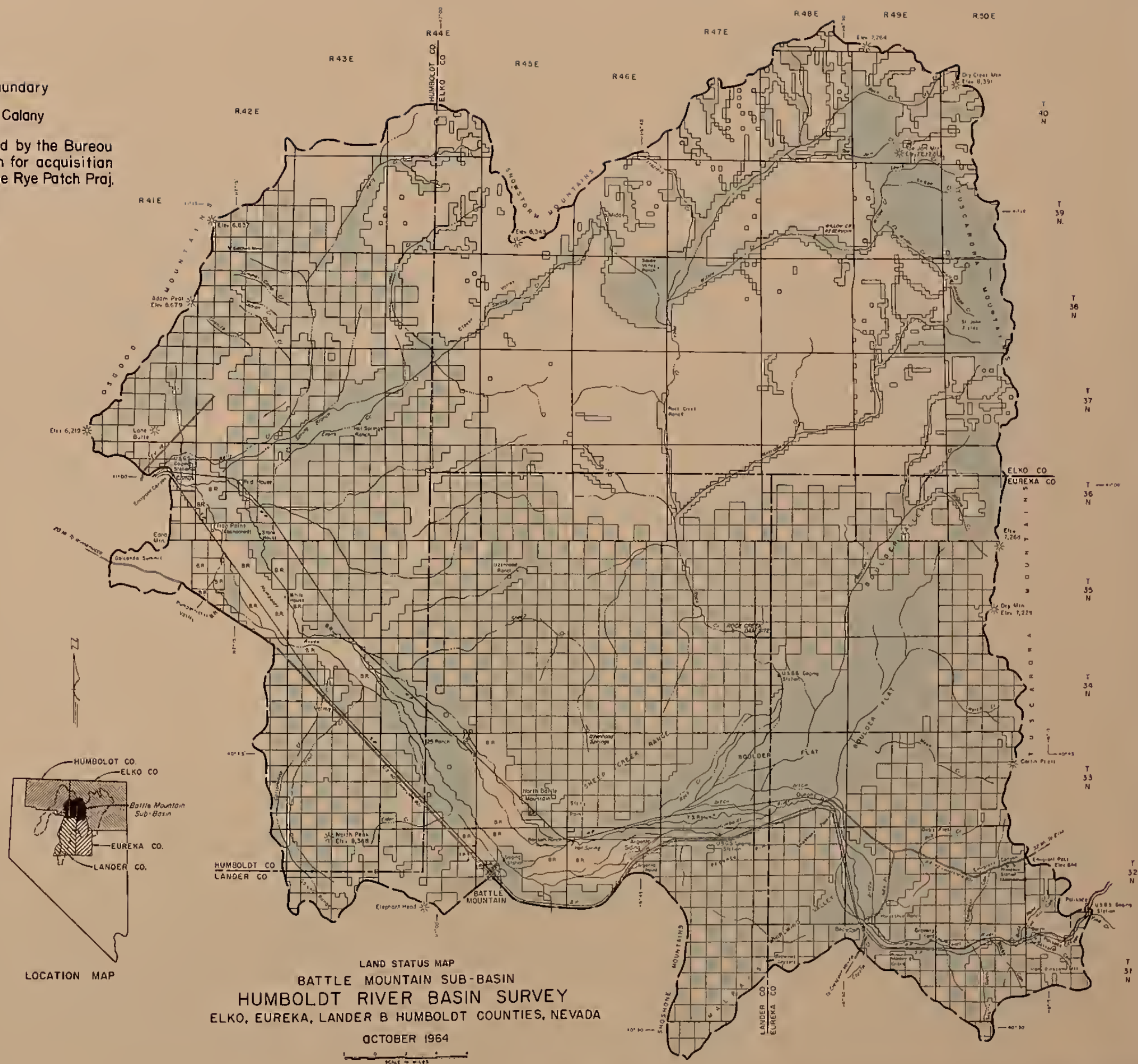
— Sub-Basin Boundary

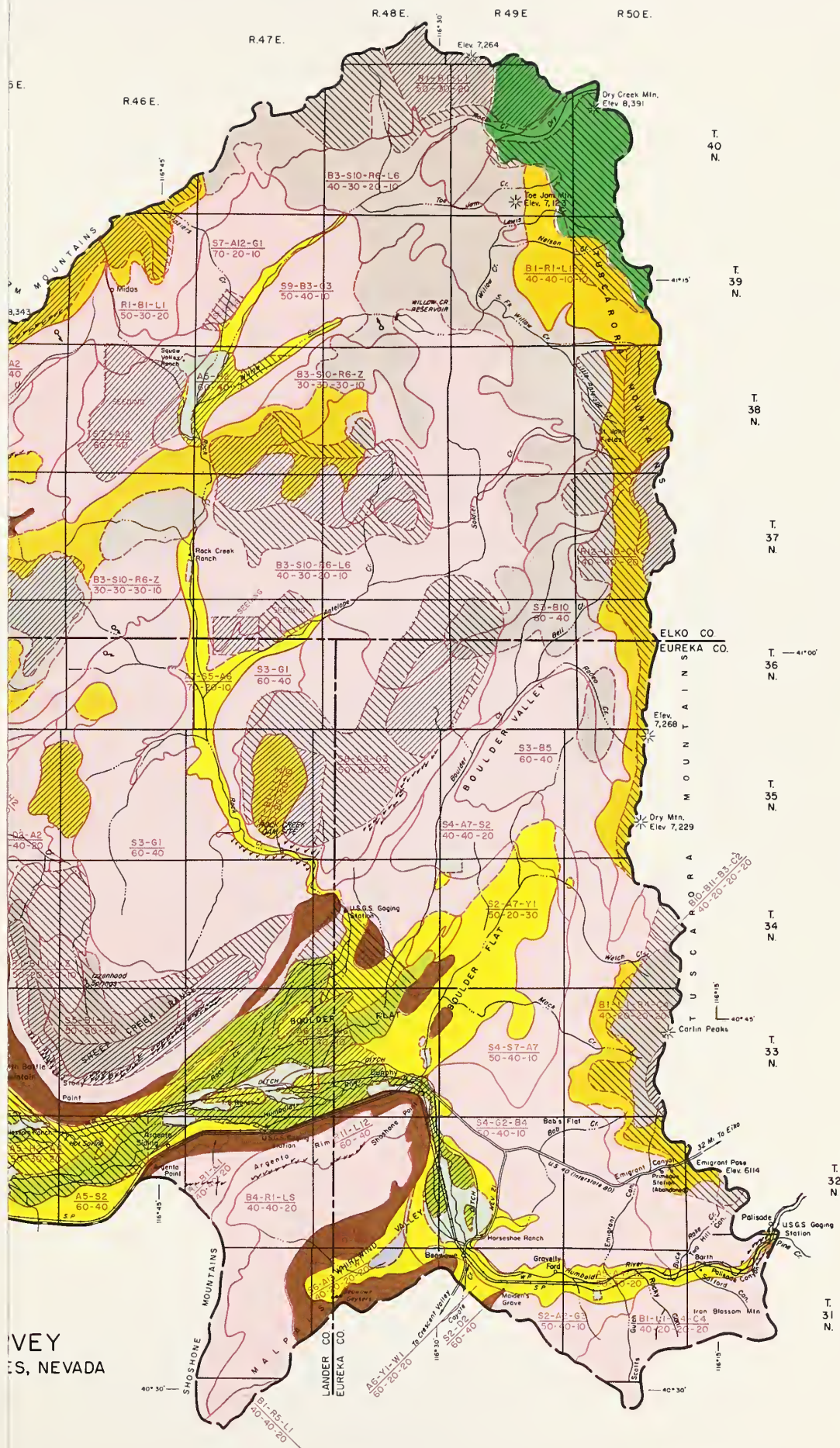
— Battle Mtn. Ind. Cany

B.R. Land purchased by the Bureau of Reclamation for acquisition of water for the Rye Patch Proj.

Private Land

Federal Land





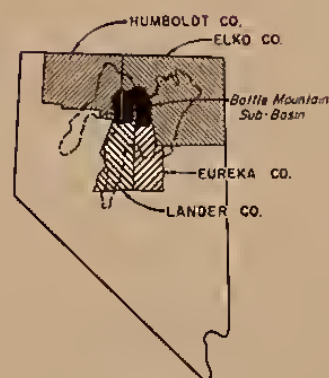
LEGEND

- Sub-Basin Boundary
- Battle Mtn. Ind. Colony
- Rock Outcrops, Inaccessible
- Great Soils Group Association Boundary

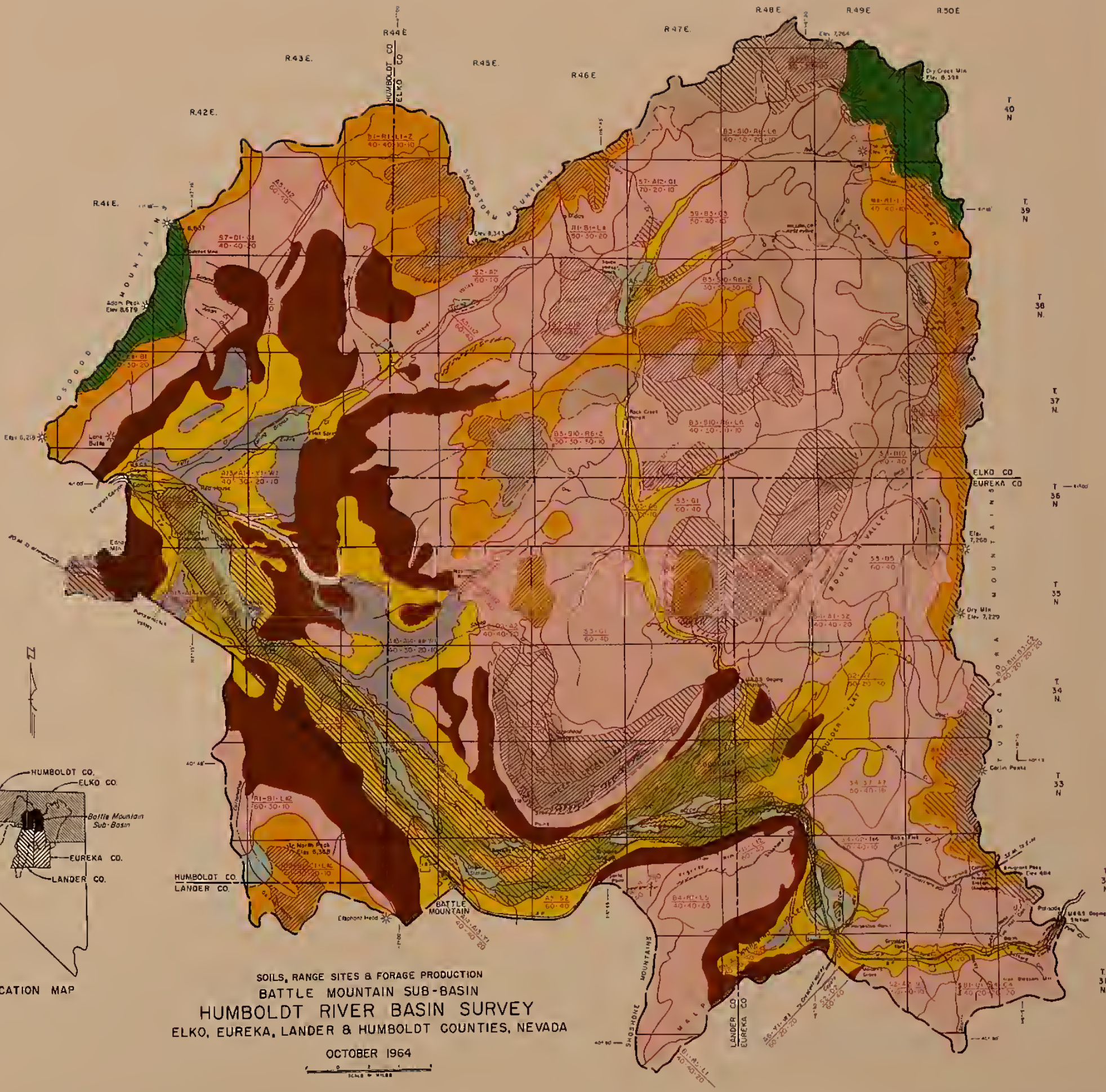
SYMBOL
 LI2-B3-C1
 70-20-10
 Association of Great Soil Groups by Phases
 Percent of each Great Soil Group Phase

RANGE FORAGE PRODUCTION RATES BY SITES

- RABBIT BRUSH - GREASEWOOD - GRASS; SALINE BOTTOMLANDS**
 Pounds dry forage per acre
 850 - 1,500
 200 - 900
 20 - 300
- MEADOW GRASSES - FORBS; SEMI-WET MEADOW**
 Pounds dry forage per acre
 1,200 - 3,000
 600 - 2,000
 200 - 1,000
- SEMI-PLAYA - GREASEWOOD - PICKLEWEEED; ALKALI BOTTOMLANDS**
 Pounds dry forage per acre
 0 - 50
- SHAOSCALE - GRASS; DROUGHTY DESERT UPLANDS**
 Pounds dry forage per acre
 100 - 350
 50 - 150
 10 - 70
- BIG SAGEBRUSH - GRASS; UPLAND BENCHES & TERRACES (includes some irrigated acreage)**
 Pounds dry forage per acre
 250 - 600
 100 - 450
 20 - 150
- LOW SAGEBRUSH - GRASS; CLAYPAN BENCHES**
 Pounds dry forage per acre
 200 - 500
 100 - 250
 50 - 150
- BROWSE - ASPEN - GRASS; INTERMEDIATE MOUNTAIN SLOPES**
 Pounds dry forage per acre
 300 - 650
 150 - 350
 50 - 200
- PINYON - JUNIPER - GRASS; SHALLOW STONY SLOPES**
 Pounds dry forage per acre
 100 - 250
 50 - 150
 10 - 75
- BROWSE - ASPEN - CONIFER - GRASS; STEEP MOUNTAIN SLOPES & BASINS**
 Pounds dry forage per acre
 350 - 800
 200 - 500
 75 - 250



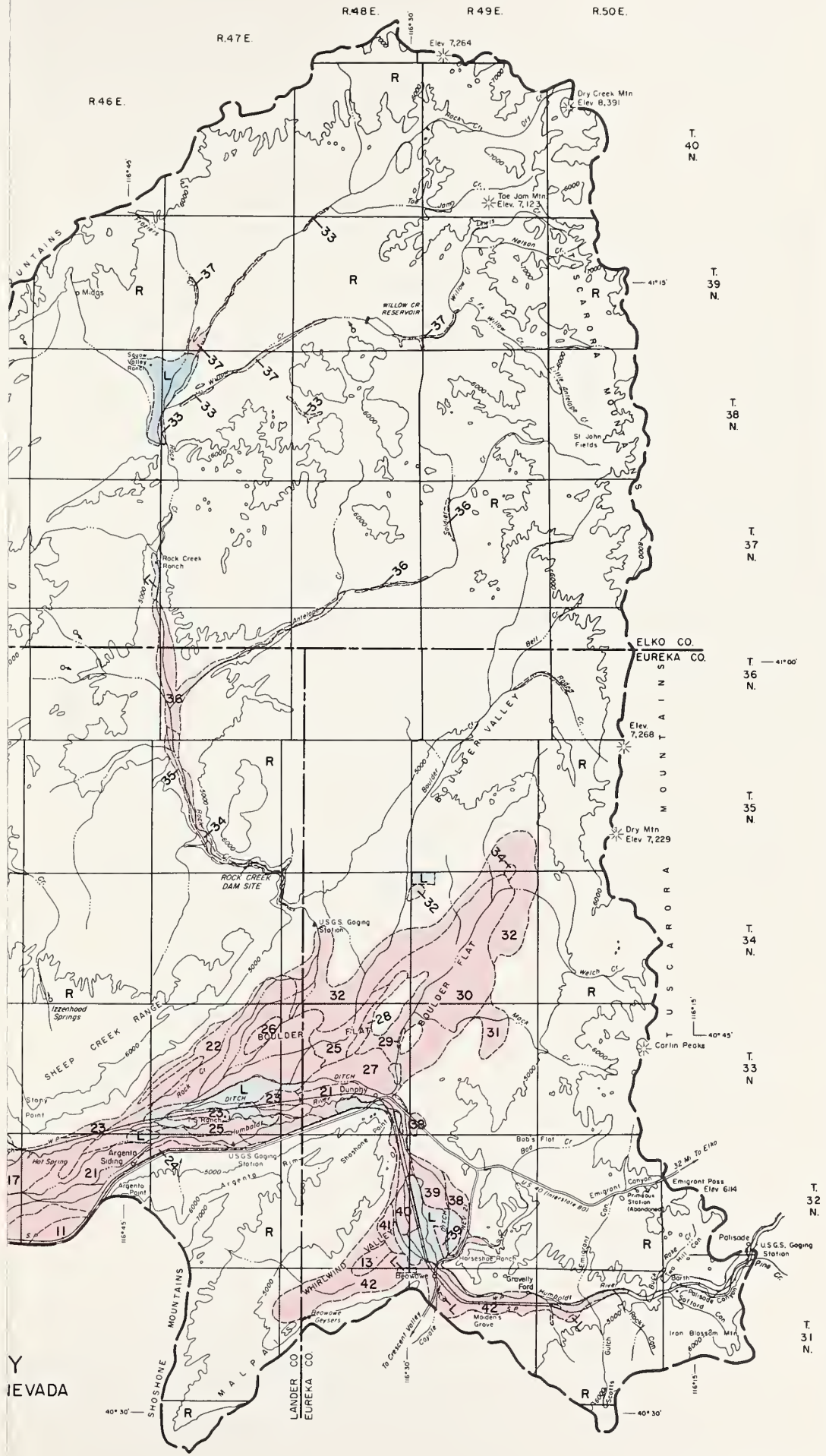
LOCATION MAP



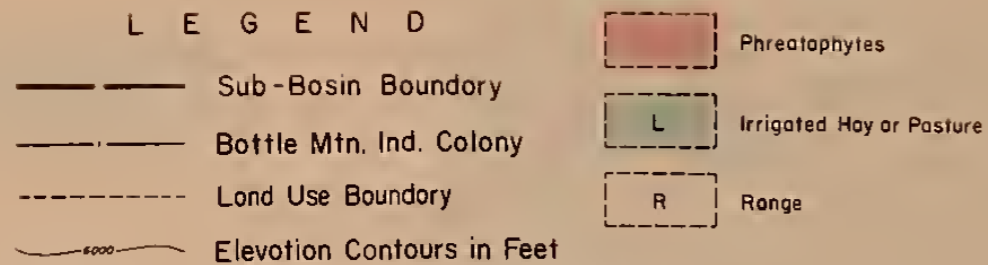
SOILS, RANGE SITES & FORAGE PRODUCTION
 BATTLE MOUNTAIN SUB-BASIN
 HUMBOLDT RIVER BASIN SURVEY
 ELKO, EUREKA, LANDER & HUMBOLDT COUNTIES, NEVADA

OCTOBER 1964

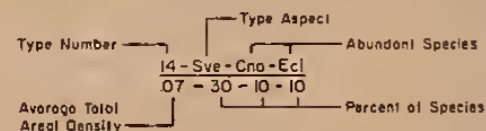




LEGEND



- | | | |
|---|---|--|
| 1. 14-Sve-Ari-Eci
.07-40-30-10 | 15. 4-Cno-Eci-Ost-Etr
.08-20-25-15-5 | 29. 4-Cno-Sve-Ari-Ost
.03-40-20-10-5 |
| 2. 2-Sai-Ost-Cno-Sve
.02-50-10-20-10 | 16. 14-Sve-Alf-Sfr
.05-35-20-5 | 30. 14-Sve-Alf-Ari
.03-70-5-5 |
| 3. 14-Sve-Alf-Sfr
.04-60-20-10 | 17. 14-Sve-Cno-Ost-Eci
.05-25-10-15-5 | 31. 14-Sve-Ari-Ars
.05-55-25-10 |
| 4. 14-Sve-Sai-Eci-Sfr
.02-80-5-5-5 | 18. 1-Eci-Ost-Cno-Sai
.10-35-20-10-10 | 32. 14-Sve-Ari-Eci
.06-50-25-10 |
| 5. 14-Sve-Cno-Ost-Sfr
.04-60-20-5-5 | 19. 14-Sve-Ost-Cno
.06-50-20-10 | 33. 4-Cno-Ari-Eci
.10-40-35-5 |
| 6. 14-Sve-Ost-Cno-Sai
.07-25-20-10-10 | 20. 14-Sve-Cno-Eci
.05-55-10-5 | 34. 4-Cno-Sve-Eci-Ari
.09-30-30-10-15 |
| 7. 14-Sve-Sfr
.04-60-15 | 21. 1-Eci-Etr-Ost-Cno
.10-30-10-10-5 | 35. 14-Sve-Ari
.08-65-15 |
| 8. 2-Ost-Sai-Etr-Eci-Cno
.08-25-15-5-15-15 | 22. 1-Eci-Etr-Ost-Sve
.15-40-5-20-10 | 36. 4-Cno-Ari-Sve-Eci
.08-40-35-10-5 |
| 9. 4-Cno-Sve-Eci-Ost
.07-30-25-15-5 | 23. 14-Sve-Cno-Eci-Ost
.06-40-10-10-5 | 37. 4-Cno-Ari-Eci-Asm
.07-40-35-5-5 |
| 10. 14-Sve-Sai-Ost-Etr
.08-15-10-15-10 | 24. 14-Sve-Eci-Sfr
.07-35-5-10 | 38. 14-Sve-Ost-Sfr-Eci
.06-40-10-10-5 |
| 11. 14-Sve-Ost-Sai-Cno
.04-50-20-5-5 | 25. 4-Cno-Sve-Eci-Ost
.15-25-10-20-10 | 39. 1-Eci-Etr-Ost-Sve
.10-20-10-5-15 |
| 12. 14-Sve-Alf-Ars-Gsp
.02-20-40-30-5 | 26. 14-Sve-Ost-Eci-Cno
.06-35-20-20-15 | 40. 1-Eci-Etr-Ost-Sai
.12-15-15-5-5 |
| 13. 14-Sve-Sfr-Ost-Sai
.02-70-5-5-5 | 27. 14-Sve-Cno-Ost-Eci
.07-55-15-5-5 | 41. 2-Ost-Sai-Sve-Cno
.08-55-10-10-5 |
| 14. 14-Sve-Ari-Ars-Gsp
.03-30-20-10-5 | 28. 4-Cno-Eci-Ost-Sai
.10-30-25-15-10 | 42. 14-Sve-Cno-Ost-Eci
.05-30-5-20-5 |



TYPE 1 GRASSLAND

Eci *Elymus cinereus* (Great Basin wildrye)
Sai *Sporobolus airoides* (alkali sacaton)
Etr *Elymus triticoides* (creeping wildrye)

TYPE 2 MEADOW

Dst *Distichlis stricta* (inland saltgrass)
Asm *Agrapron smithii* (western wheatgrass)

TYPE 3 PERENNIAL FORBS

Sfr *Suaeda fruticosa* (alkali seepweed)

TYPE 4 SAGEBRUSH

Ari *Artemisia tridentata* (big sagebrush)
Cna *Chrysothamnus nauseosus* (rubber rabbitbrush)
Ars *Artemisia spinescens* (bud sagebrush)

TYPE 13 SALTBUCH

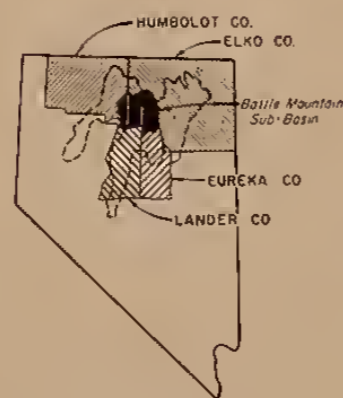
Atf *Atriplex confertifolia* (shadscale saltbrush)

TYPE 14 GREASEWOOD

Sve *Sarcobatus vermiculatus* (black greasewood)

TYPE 16 DESERT SHRUB

Gsp *Grayia spinosa* (spiny hopsage)



LOCATION MAP

LAND USE & PHREATOPHYTE MAP BATTLE MOUNTAIN SUB-BASIN HUMBOLDT RIVER BASIN SURVEY ELKO, EUREKA, LANDER & HUMBOLDT COUNTIES, NEVADA

OCTOBER 1964

SCALE 1:50,000

NATIONAL AGRICULTURAL LIBRARY



1022318688

2

NATIONAL AGRICULTURAL LIBRARY



1022318688